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# TechnologyReview

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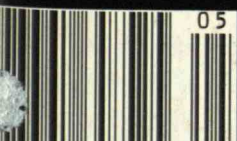
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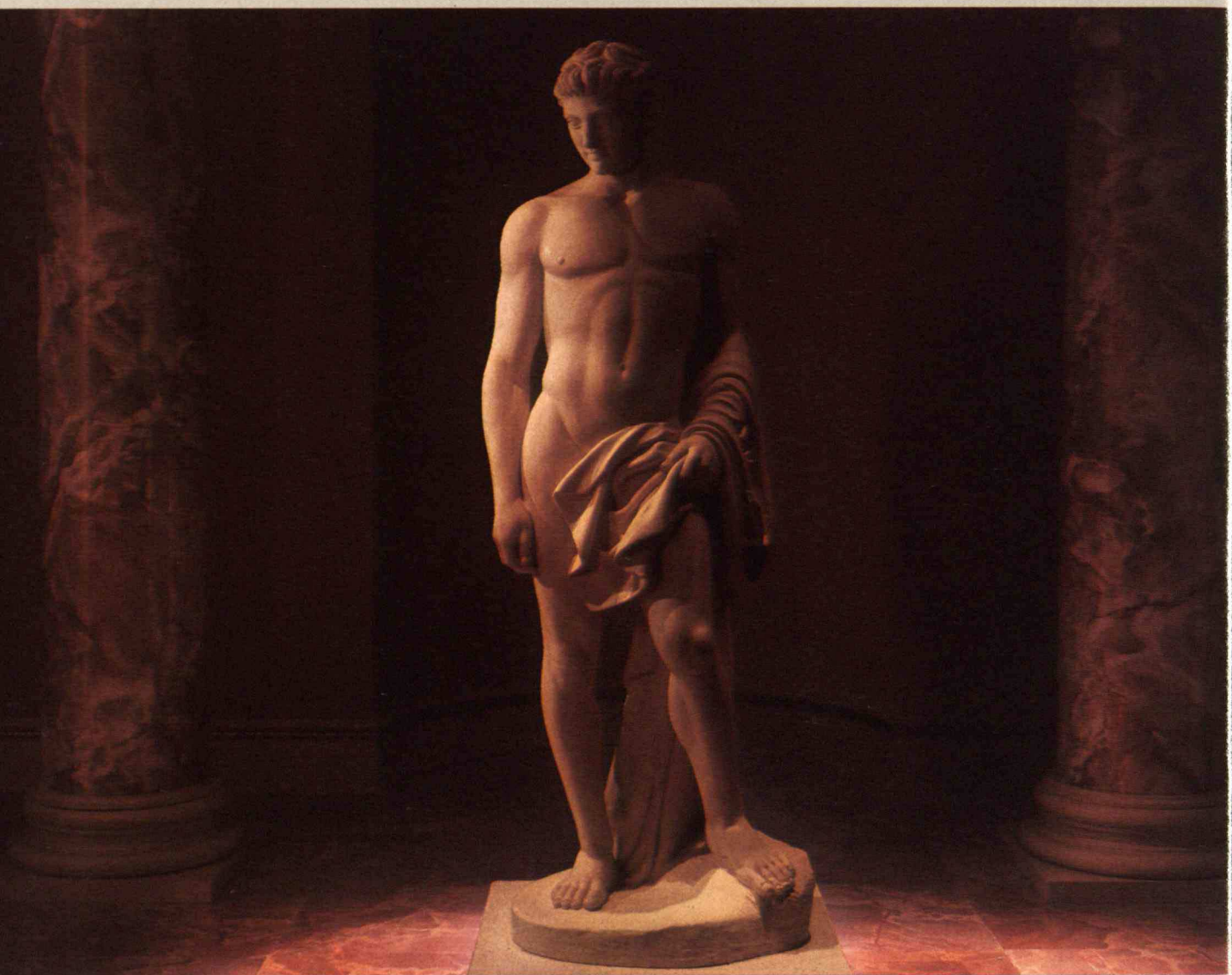
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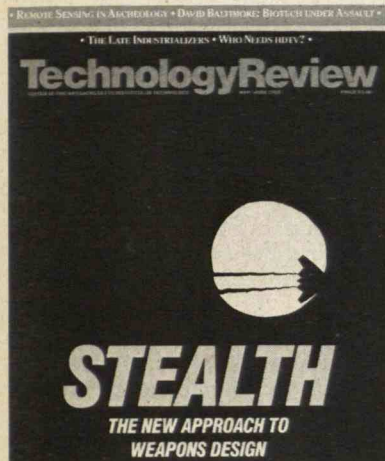
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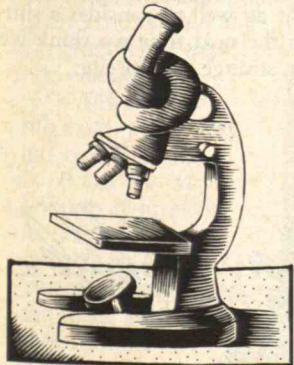
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## FIRST LINE

FROM THE EDITOR

# Stopping Killer Bees with Star Wars

Not long ago I stayed in a little concrete house in Ecuador that stood among the incredibly green Andean fields, had a view of the snow-capped peak Chimborazo, and supported six hives of "killer bees" on the roof. The bees proved a real disappointment. When it rained, which was often, they hardly left the hive. When the sun appeared, they collected pollen among the children and chickens that ran in the mud. I was stung once because I was foolish enough to sit right below the hives while holding something sweet. It hurt no worse than the sting of gringo bees.

Imagine my interest when I later heard on the "MacNeil Lehrer News Hour" that these industrious bees from South America were heading to the U.S. border "destroying people, animals, and crops as they go." The announcer further claimed that the "primary" U.S. advantage over "other countries that have faced killer bees" lay in "scientific spillover" from Star Wars. Star Wars versus killer bees? A physicist working on the Strategic Defense Initiative (SDI) who was interviewed said, "To couch it in a simple algorithm, tracking a reentry vehicle at 100 kilometers is about the same problem as tracking a honey bee at 1 kilometer." It sounded like a shoot-out at the Rio Grande.

The remainder of the news report made it clear that tracking bees is actually quite a different sort of problem from tracking ICBMs. The bees cooperate by shouldering little solar-powered laser transmitters, a favor not normally granted by incoming warheads. The hope is that bee tracking "might provide just the insight into honey bee biology that could lead to an effective bee control program." Subsequent research on my part suggested that even this hope is tenuous. The device weighs 45 grams, no small burden for honey bees, and is expected to alter their behavior.

If apian Star Wars offers small comfort, what danger is posed by the apian threat? I checked with Roger A. Morse, who is chairman of the Department of Entomology at Cornell and has studied bees in over 50 countries. He assured me that Africanized bees, as they are properly called, pose no undue dangers, except perhaps in the media.

These bees are somewhat more aggressive in defending the hive than the Euro-

pean bees now in North America, but this characteristic is readily handled by proper management, for example keeping the hives well spaced so that a disturbance to one doesn't affect its neighbors. Moreover, Africanized bees have important advantages. They are more resistant to disease, probably better pollinators of crops, and excellent honey producers.

Why then the stories of "killer bees" and science to the rescue—chemical barriers, biological barriers, now Star Wars? Perhaps these scenarios arise in part from a streak in the U.S. character that fears "foreign entanglements" and wishes the oceans would keep them hence. Innocent of any real understanding of some strange import, we envision disaster and, with equal innocence, call technology to the rescue. Just as it conquered the frontier, so technology will make borders inviolate.

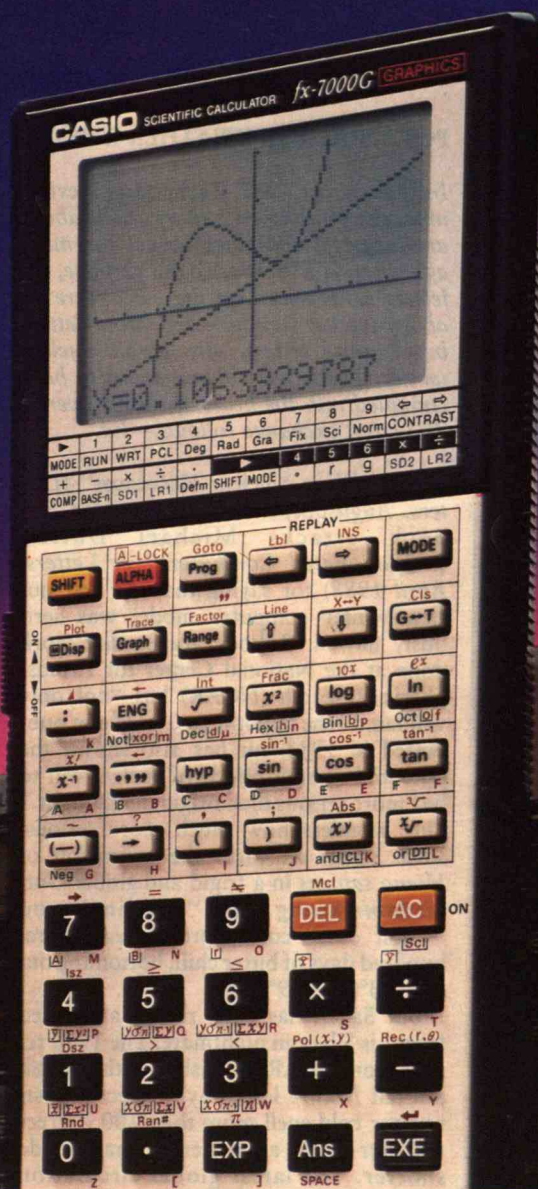
In this sense, Star Wars and killer bees do belong together. Soviet missiles are, of course, a genuine danger, but by the mid-1980s the doomsday vision of all-out attack had grown into a Hollywood fantasy almost analogous to killer-bee movies such as *The Swarm* or *Terror out of the Sky*. Although even Richard Nixon declared that "the Soviet Union is now a status quo power," our ostrich-like leaders shut their eyes to the actual political situation and with equally blind faith called technology to the rescue. It is now clear that political change on both sides has done far more to ease U.S.-Soviet tensions than Star Wars ever could.

As for the Africanized bees, North Americans will have to learn to deal with them just as South and Central Americans have. We could acquire the technology of managing them from Brazil, where African bees were released in 1957, instead of imagining bizarre high-tech defenses. Given the increase in global communication, we might do well to consider a similar approach the next time we think we see something strange and foreign.

  
JONATHAN SCHLEFER



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# Nuclear Winter Controversy

## POST-NUCLEAR WEATHER REPORT

*In October of 1987, Technology Review innocently published a short article about an imperfect computer model for managing national forests. To our surprise, the letters we received on the piece were all about nuclear winter—and those letters begot more letters, also about nuclear winter. The letters column seems to have stumbled into the heart of a controversy. The latest exchange follows.—Ed.*

In "Modeling Nuclear Holocaust" (*Letters*, August/September 1988), Alan Robock attacks Michael Dutton ("Opinionated Computers" in *Letters*, April 1988) for saying that the first nuclear-winter computer model was seriously flawed. Robock argues that work done at the National Center for Atmospheric Research (NCAR) has "not only validated" the hypothesis Carl Sagan publicized in 1983 but has also shown the potential climatic effects of nuclear war to be "more serious than originally thought." One wonders how much more serious, since Sagan set forth the extinction of *Homo sapiens* in a frigid and global *Gottterdammerung*. His "baseline" and "worst case" curves prophesied several hundred days of bitter chill, bottoming out at  $-53^{\circ}\text{C}$  ( $-59^{\circ}\text{F}$ ).

But Sagan has been rudely awakened from his Siberian nightmare. The 1988 results from NCAR, published in the British journal *Nature* last May, project a post-nuclear cold spell more than 100 degrees warmer—and an order of magnitude shorter. The latest global circulation model has average U.S. summer temperatures falling only into the 50s Fahrenheit. Nuclear war retains its intrinsic environmental terrors, but nowhere this side of Palm Beach do a few weeks in the 50s a winter make.

Have the "nuclear winterists" failed to notice how their denial endangers the credibility of environmental modeling? If, to quote Robock, there is something "too horrible to contemplate," it is the risk that his own brazen stonewalling will cast doubt on more valid models and the real threats they can warn us of. Sagan's big chill has been exorcised, but the greenhouse effect is *not* just a ghost in a machine.

RUSSELL SEITZ  
Cambridge, Mass.

*Russell Seitz is an associate of the Center for International Affairs, Harvard University.*

### The author responds:

Russell Seitz is confused, partly because he is reading my letter through conservative-colored glasses. He focuses on the most extreme of more than 27 different scenarios in the early article on nuclear winter. Furthermore, the NCAR work has validated, not disproved, the nuclear winter theory.

Another reason for Seitz's confusion might be that essential details were left out of the edited version of my argument. First, the climatic effects of nuclear war would be more prolonged than originally thought, and second, my own research has demonstrated the long-term climatic effects as well as provided several examples of surface cooling caused by forest-fire smoke in the atmosphere.

The threat of nuclear winter has been recognized not only by the world scientific community but by the world political community. On December 7, 1988, the United Nations General Assembly voted to accept a U.N. report confirming the nuclear winter theory. For the first time, all the nations of the world have agreed that the use of nuclear weapons would result in an unprecedented holocaust for the people of combatant and non-combatant nations alike. Thus, the warnings of scientists using computer models and analogs from nature have played an important part in the move to reduce the number of nuclear weapons, a much larger and more immediate danger than greenhouse warming.

## MILITARY RADIOACTIVE WASTE

As scientists and engineers who are alumni of MIT working at the Savannah River Laboratory, we were extremely disappointed with the article by Alvarez and Makhijani. The allegations the authors make are not new and were published several years ago in more detail by Mr. Alvarez. After that report was issued, 70 of the "facts" or "subjective opinions" expressed were refuted in a publication compiled by many experts in the field.

We agree with Alvarez and Makhijani that liquid wastes pose the most serious immediate risk to workers and the public. That's why there has been over a decade of intense research on developing glass-

*Continued on page 7*



A new test fixture precisely determines the capabilities of integrated circuit chips with frequencies up to nine gigahertz. Developed by Hughes Aircraft Company, it provides clear electrical characterizations of gallium arsenide chips, which operate six times faster than chips made of silicon. Accurate information about how these chips perform under a variety of conditions is required before a circuit can be designed. The new test fixture can be used to generate data showing component performance characteristics such as voltage, current, and frequency as functions of environmental stress.

An integrated security management system that can monitor and display security and fire alarms will help security forces operate more efficiently. The system, designed by Hughes for General Motors' Regional Personnel Administration, will integrate new and existing systems in 180 GM plants throughout the United States. GM will establish 12 Regional Personnel Centers (RPCs) to serve the plant sites. Each RPC will perform central monitoring and control, rather than each plant site performing its own, as is presently the case. The new system has the potential to save GM millions of dollars each year. A similar Hughes-designed system is currently installed in the Smithsonian Institution in Washington, D.C.

Sophisticated guidance and control electronics enable a U.S. Navy torpedo to operate as a single, integrated system. The guidance and control subsystem of the Mk-48 Advanced Capability (ADCAP) torpedo, now in production at Hughes, is programmed in the Navy's Standard CMS-2 software language to continuously coordinate information from the weapon's autopilot, inertial navigation system, sonar array, and the ship's fire control system. Prior to launch, the submarine's fire control system sets attack functions in the torpedo's guidance and control subsystem. After launch, the torpedo receives updated information from its own sensors, and from the submarine via a long, thin communications wire, increasing the probability of the torpedo hitting its target even under acoustically warped conditions.

A revolutionary three-dimensional architecture will result in an ultra-fast supercomputer that fits into the palm of a hand. A 3-D computer, under development by Hughes for the U.S. Air Force, uses a three-dimensional array of processors to achieve an extremely high degree of parallel processing. The array of processors is distributed vertically on integrated circuit wafers, stacked one on top of another, eliminating circuit boards, chip packages and connectors. This allows as much as 90 percent of the computer to be active silicon circuitry. Final versions of the computer will handle 100-billion operations per second for applications like image processing, radar signal processing, and space-based missions.

Avionics systems that can automatically reconfigure themselves, or operate in a degraded mode, will be built into the structure and skin of future aircraft. The research into these systems, called "smart skins," is being conducted by Hughes for the U.S. Air Force. Instead of discrete "black boxes" connected by individual wires, smart skins will consist of antennas, transmitters, receivers, sensors, processors, controllers, and communications channels built into the frame and outer skin of an aircraft, with as much as 50 percent of the aircraft's surface area covered by sensors and antennas. These systems have the potential for extremely high reliability and continued operation even during periods of intense combat.

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Effective and permanent disposal of highly radioactive waste must be performed in our generation. We believe that the technology is available and that the scientists and engineers in the field are well-trained and dedicated. With the assistance of responsible people and independent peer-review groups, we will do the job and do it right.

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A pox on *Technology Review* for the sensationalized August/September cover announcing the article by Robert Alvarez and Arjun Makhijani. The magazine should not attempt to emulate the *National Enquirer*.

WILLIAM E. MOORE II  
Charleston, W.Va.

The problems Alvarez and Makhijani outline are indeed frightening and will only be exacerbated as we add radioactive waste from commercial nuclear operations to radioactive military waste. But the desire for an immediate halt to plutonium production cannot be realized, since current nuclear power plants routinely convert uranium into plutonium as a natural by-product of fission. Worse, the world will have to convert to breeder reactors to keep the nuclear power industry going as

uranium ore becomes scarce, and this will make the sheer quantity of plutonium produced much greater than it is today.

Also, the authors conclude that soil dumping of radioactive waste should stop, and indeed a number of nations, with limited land available for nuclear-waste disposal, are looking to the seabed. However, one can't help but wonder if seabed disposal could turn out to be even more problematical than earth burial.

J. RICHARD SHANE BROOK  
Schenectady, N.Y.

#### EVOLUTIONARY COMPUTERS

In "Genetic Algorithms" (*TR January 1989*), Charles T. Walbridge sets up a game called Vector to illustrate the genetic algorithm he proposes. In this game, one player thinks of a string of six digits, all of which are either 1s or 0s, and the other player has to guess what the string is in as few tries as possible. After each try, the player who has thought of the string gives the other player a "score"—the number of correct digits in the try. Of course, the perfect score is six.

Walbridge lets go with a "eureka!" when his algorithm allows him to guess the string in sixteen tries. However, I have devised a strategy that would reveal the answer much more quickly. First, make the first try all 0s. Then just insert a 1 as the first digit of your second trial. If your score is lower, make the 1 a 0 and use a 1 for the second digit in the next trial string. If your score goes up, retain the 1 and move to the next digit. Keep repeating the operation. You will solve the problem in only seven trials at best.

Furthermore, I have grave doubts about the evolutionary data Walbridge uses. He says many biologists think evolution operates "only through a sudden change in the genetic material." Yet even Stephen Jay Gould would admit that punctuated equilibrium is punctuated not instantaneously but over thousands of years. He also says the "only real function" of mutation is to "restart a process of evolution that has stalled," but this implies that there is a goal toward which evolution is striving.

I can only conclude that what artificial intelligence needs are machines with the power to replicate themselves while making an occasional mistake. The copies and mistakes would be subjected to a changing habitat in which they would have to maintain themselves long enough to replicate.

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Some of them would have to withstand periods in which most machines would become extinct. Given enough fortuitous changes, we could get an intelligent machine. But there ought to be a more interesting way to create one.

DELBERT OXLEY  
Seattle, Wash.

There is something grossly wrong with Mr. Walbridge's game Vector as an illustration of genetic problem solving. The negation of the digits he calls trial string A is 101010, which yields a score of 5 in the game. The negation of trial string B is 000010, which also yields a score of 5. Therefore any string ?0?010 will score at least 4. The simplest one-bit modification is 001010, which scores 6. I win with one try. This logic doesn't take much intelligence, artificial or otherwise.

MALCOLM A. BEERS  
Rochester, N.Y.

I enjoyed "Genetic Algorithms," but I think it contains an error. Walbridge refers to the "48 chromosomes" that "define a human being." In fact, there are 46 chromosomes in the human species, not 48. These are the diploid numbers of chromosomes—the chromosomes that one can photograph under a microscope.

VELMA FORD MORRISON  
Princeton, Ill.

I enjoyed the article on genetic algorithms. But to set the record straight, please note that I conceived of evolutionary programming while serving at the National Science Foundation in 1960, completed a doctoral dissertation on the subject at UCLA in 1964, and published the book *Artificial Intelligence through Simulated Evolution* (John Wiley and Sons) in 1966. This laid the foundation for much of the work reported in the article.

LAWRENCE J. FOGEL  
San Diego, Calif.

#### The author responds:

I don't mean to slight readers Beers and Oxley, but they are using too much intelligence. While their strategies are perfectly sound, blind groping by the genetic algorithm gets the same answer with no intelligence whatever. Furthermore, when the strings are, say, 50 bits and the lists are 200 strings long, unaided human intelligence is overwhelmed (mine is anyway, and it doesn't get much more unaided than that). The machine, on the other hand, keeps grinding.

In answer to Mr. Oxley's doubts about my evolutionary data: punctuated equilibrium is the hypothesis that evolution proceeds by jumps. Species that have been stable for millennia can suddenly change, producing new species and taking over new environments. The reason for this may be that when the rare useful mutation occurs, it spreads throughout a population, causing the whole species to change. The same thing happens with genetic al-

# NORTHWEST

## THERE'S NOTHING SIMPLE ABOUT A BUSINESS TRIP TO OSAKA

The complexities of doing business in Osaka can be overwhelming. Not only is the language foreign, but the rituals and business practices are quite different from our own. For this reason, the power of having just a little knowledge beforehand should never be underestimated.

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gorithms. Moreover, there is indeed a goal toward which evolution is striving: staying alive. Organisms have to be capable of changing. Otherwise when crisis—or opportunity—strikes, they die.

As to the business of “48 chromosomes,” I suppose I could say that when I went to school we were told we had 48 chromosomes—and the country had 48 states. I could go on to say that since then two of the chromosomes have seceded from the human genome to become states. But I will tell the truth: “48” is a mistake. Reader Morrison is absolutely right. In typography, as in nature, most mutations are useless.

And my apologies to Mr. Fogel. In my effort to explain the genetic algorithm, I managed to neglect most of the people who made it possible.

#### VALE OF TEAR GAS

The Trend “Not Tears Alone” by Ellen Cantarow (TR October 1988) is flawed

and unfair. Ms. Cantarow uncritically accepts testimonials about Israeli use of CS tear gas from biased Arab and U.N. sources. Not only that but every miscarriage, infant death, or other untoward incident is attributed to CS gas. Such a lack of objectivity would not be accepted anywhere else in *Technology Review*.

The photograph of Palestinian youths throwing baseball-sized rocks, potentially fatal missiles, graphically illustrates the need for protection of law-abiding Arabs and Jews. Threats from extremist Arab groups have closed businesses, and Arabs have even killed other Arabs to enforce anti-Israeli action. Indeed, the Israeli security forces have acted with remarkable restraint given the provocations.

Finally, the reports on Israeli use of CS gas are especially unfair given that the press has virtually ignored the Iraqi use of poisonous gases against its own citizens.

MICHAEL A. ROSNER  
South Hadley, Mass.

#### CORRECTION

In “Can the U.S. Economy Survive a Few Nuclear Weapons?” (April TR), the chart on the top of page 26 was drawn incorrectly. The line showing demand for food after a nuclear exchange should be switched with the line showing capacity to fulfill the demand. Survivors would die because they could not obtain the food supplies that did remain. Also, the sentence on page 28 referring to accelerated transportation rebuilding should say the economy still functioned at only two-thirds its previous level rather than a third.

“Not Tears Alone” is disturbingly polemical. Ms. Cantarow quotes only Palestinian sources directly. Not unexpectedly these sources are interested in magnifying their “innocent victim” role. She fails to even address the issue of sharp rocks aimed at Jewish civilian skulls or Molotov cocktails thrown at family cars.

*Continued on page 77*



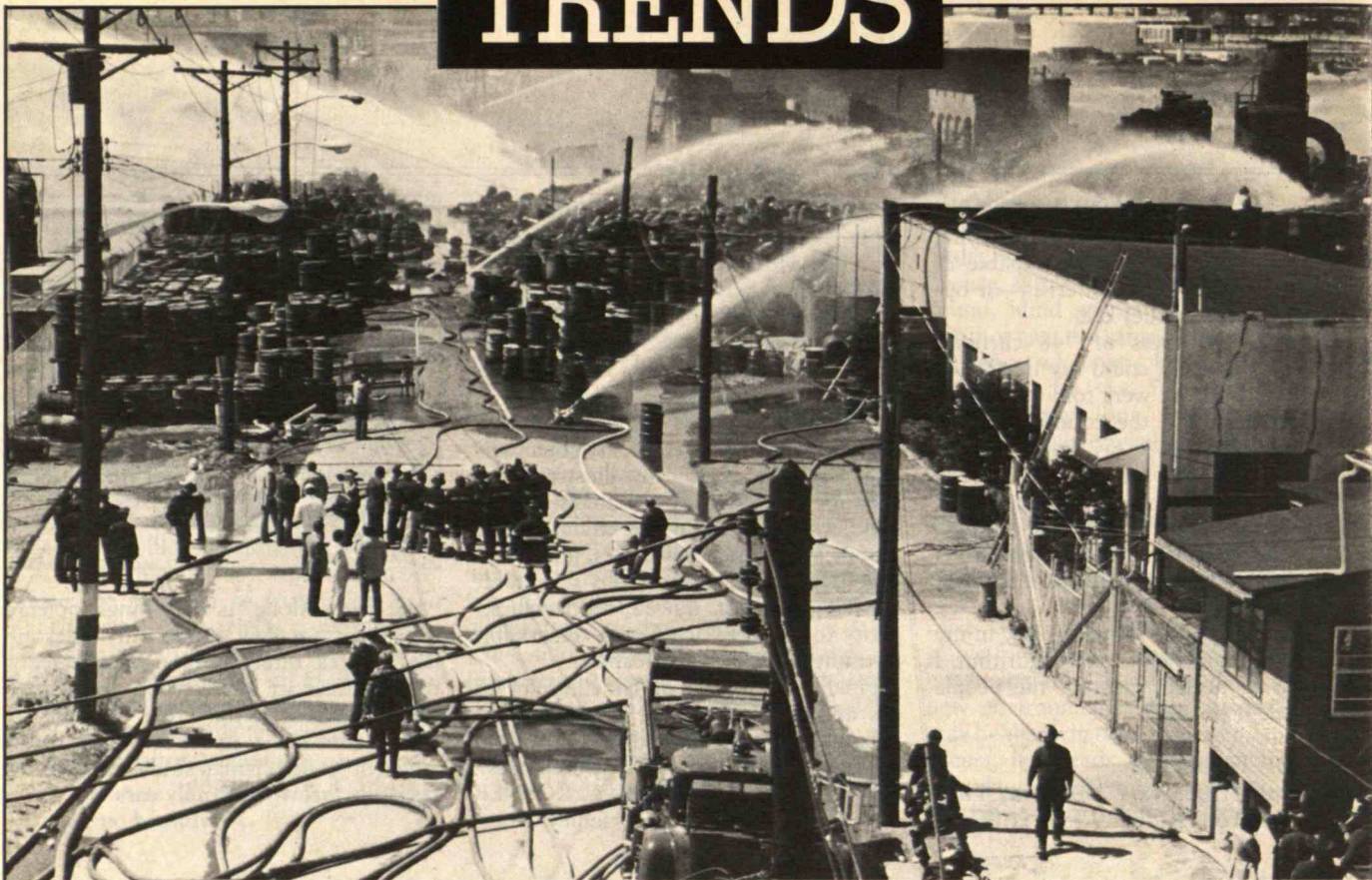
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# TRENDS



## Toxic Training

**E**ight years ago, 100 firefighters from Elizabeth, N.J., and surrounding communities spent 10 hours combatting flames and explosions at the Chemical Control Corp. Nearly 30 firefighters were injured, and fumes from burning chemicals may have exposed others to long-term health problems. Moreover, in putting out the fire, "acids were washed into the river," says Michael Melchione, fire captain that night. Few of the firefighters fully understood the risks—to themselves or the community—of leaking barrels of chemical waste.

Since then, members of the Elizabeth department have attended courses explaining the dangers and how to deal with them. But until recently few such classes were available to those who must be ready to respond to toxic emergencies—not only fire-

fighters but emergency medical technicians, police, and the nearly 65,000 people employed in managing or cleaning up hazardous materials. Even now, education programs may reach too few people with too little information. An estimated 25,000 hazardous-material spills each year threaten over 1 million U.S. workers.

Some private firms have trained their own safety teams for more than a decade. The

Coast Guard and a few other federal agencies have also offered classes, again mainly for their own personnel. The Environmental Protection Agency (EPA) has done most of the rest of the training. Since 1979, it has hired contractors to educate all levels of hazardous-waste workers—from police and firefighters to site managers. In 1988, EPA's Environmental Response Team taught more

**Firefighters battling this blaze in Elizabeth, N.J., didn't know the dangers of the burning chemicals.**

than 5,300 people. The Office of Solid Waste and Emergency Response is developing education packages targeted at EPA officials who manage cleanups at spills and Superfund sites.

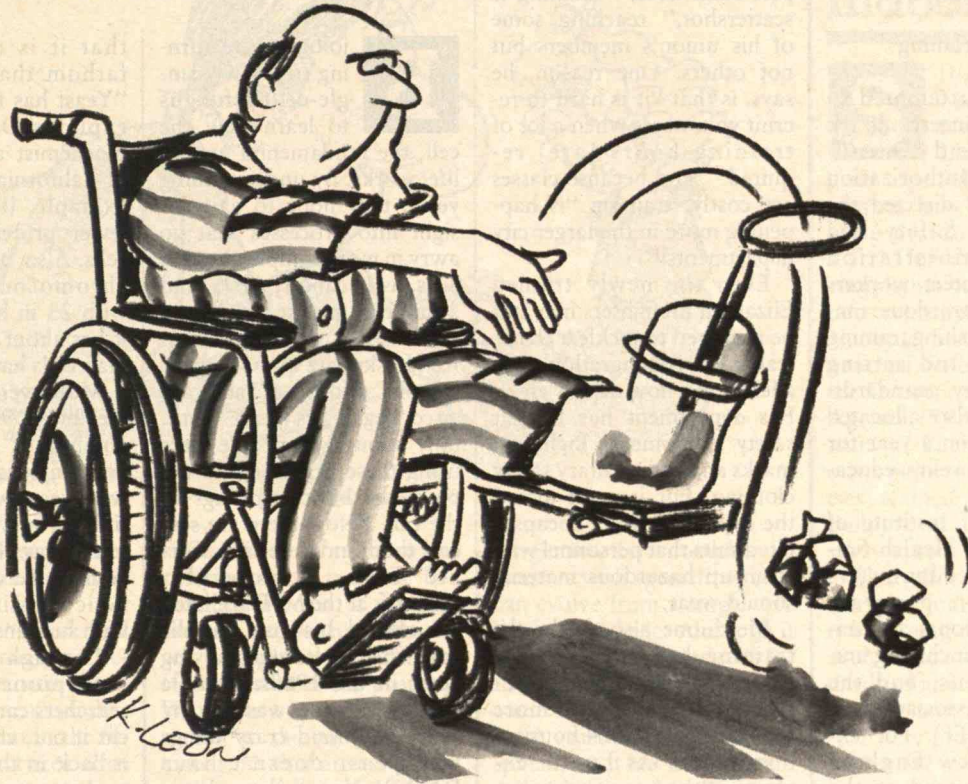
Yet EPA's programs are limited. Jack Luskin, a health physicist at the University of Lowell in Massachusetts, notes that the agency has trained few people who actually work at waste sites daily. Thomas Sell, training coordinator for the Environmental Response Team, acknowledges that police and other emergency responders have filled the courses, but he says the agency is broadening participation.

However, Luskin points to a bigger problem: "The numbers of people they can train each year are severely limited," Sell agrees. "We have a long waiting list of people





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\*\*These policies meet the minimum standards for major medical insurance as defined by the New York State Insurance Department. They do NOT provide basic hospital or basic medical insurance. The expected benefit ratio for these policies is 55 percent. This ratio is the portion of the future premiums which the company expects to return as benefits, when averaged over all people with a policy.



who want to take our courses." Answering the demand requires money.

### Broad-Brush Training

Congress has attempted to address these concerns. In the 1986 Superfund Amendments and Reauthorization Act (SARA), it directed the Occupational Safety and Health Administration (OSHA) to protect workers who handle hazardous materials by establishing training requirements and setting health-and-safety standards. Congress has also allocated up to \$10 million a year for five years to develop education projects.

The National Institute of Environmental Health Sciences (NIEHS) administers the education program through 11 regional and national grantees, including universities, unions, and the International Association of Firefighters (IAFF). For example, the New England Consortium, based at the University of Lowell, is an amalgam of universities and labor groups in four states. Luskin and his consortium colleagues have trained state police, firefighters, transportation workers, industrial emergency responders, and others, with courses tailored to each.

Even the SARA program has critics, though. One problem is that OSHA hasn't finalized guidelines for certifying workers. The agency is waiting for the Office of Management and Budget to review the proposed rules. In the meantime, supervisors hesitate to send employees to NIEHS programs, since OSHA could change the criteria for certification.

In addition, the firefighters' association maintains that the SARA requirements need

strengthening. According to IAFF safety-and-health expert Alan Beer, "Training is scattershot," reaching some of his union's members but not others. One reason, he says, is that "it is hard to recruit volunteers when a lot of training hours [are] required." And because classes are costly, training "is happening more in the larger city departments."

Even the newly trained Elizabeth firefighters may not be prepared to tackle a chemical-waste conflagration, says Melchione, now deputy chief. His department has bought safety equipment, including masks and rudimentary safety clothing, but it can't afford the expensive, fully encapsulated suits that personnel who clean up hazardous material should wear.

Melchione also thinks the training has been "broad brush." Emergency responders seldom get more than the required 24 hours of instruction. As Luskin explains, "there are so many hazards and so much a person needs to understand that all we can do in a 24-hour or 40-hour course is provide an overview." Nevertheless, he adds that if workers learn about risks and realize the need to learn more, then the courses are a step forward.

In December 1988, a broken high-voltage wire sparked a fire at Reliance Universal, Inc., a paint factory in Louisville, Ky. The firm's fire team quickly controlled the blaze, and no one was injured. Company fire chief George Taggart credits the training his team received from both EPA and the Center for Worker Health and Safety Education in Cincinnati, Ohio, an NIEHS grantee. ■

THOMAS KIELY is a regular contributor to *Trends*.

## Field in Ferment

**B** iologists are turning to a lowly single-celled fungus to learn how the cell, the fundamental unit of life, works. By understanding yeast, they hope to gain insight into processes that go awry in more complex human cells, as in cancer, AIDS, and a range of genetic disorders.

In 1971, when geneticist Ira Herskowitz of the University of California at San Francisco began his yeast work, only about 100 people were using these organisms to explore the basic workings of the cell. "Now there are several thousand," he says. Gerald Fink, a molecular biologist at the MIT-affiliated Whitehead Institute, recalls that when he started studying yeast in the 1960s, "people told me I was wasting my time. They said crazy things like yeast doesn't have DNA." Yeast does have DNA, as well as genes and chromosomes. In fact, Fink adds, "every time we go looking in yeast for some supposedly higher biological process, we find it."

Unlike bacteria, yeast has the same basic design as human cells. A nucleus contains genetic material; a membrane separates the nucleus from the bulk of the cell; and a cytoskeleton provides structure. Both yeast and human cells are classified as eukaryotes. (Bacteria, which lack a nucleus, are prokaryotes.) Yeast can be used to examine virtually "anything that has its basis in the biochemistry of eukaryotic cells, including cancer," notes University of Washington geneticist Lee Hartwell.

One important advantage of working with the fungus is

that it is much easier to fathom than human cells. "Yeast has few extra parts," explains David Drubin, a biochemist at the University of California at Berkeley. For example, its cells have far fewer proteins than human cells. Also, a yeast cell has 17 chromosomes, compared with 23 in human cells. And it has about 5,000 genes; human cells have about 40,000.

Moreover, yeast regenerates every 90 minutes. "The amount of genetic crossing you can do in a couple of days with yeast would take a lifetime if you were working with mice," says Drubin. "And, of course, we can't do *any* genetic-crossing experiments with humans."

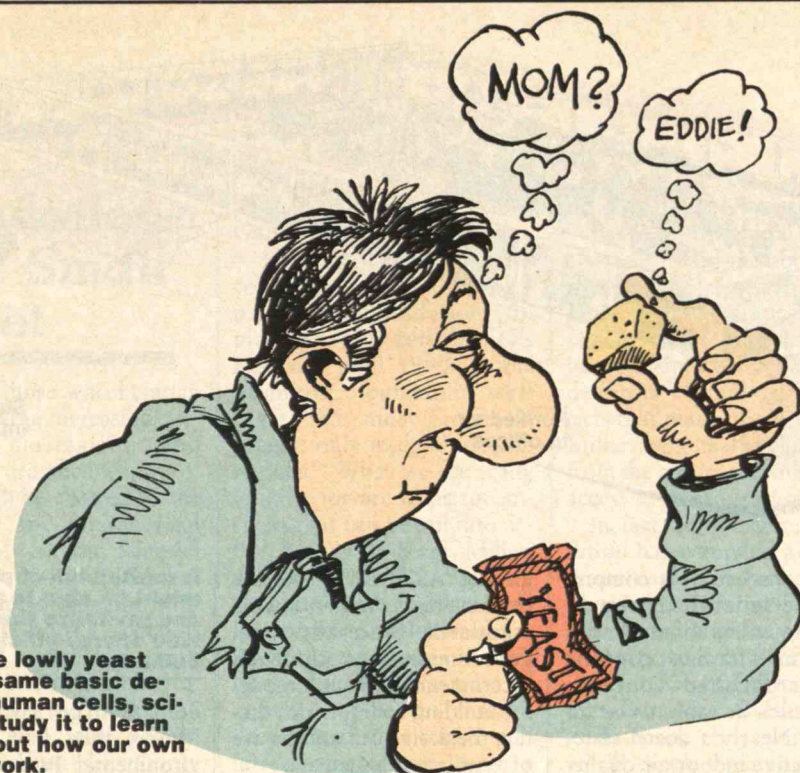
Through a process that Fink pioneered, yeast researchers can target any gene, cut it out, change it, and put it back in the same place on a chromosome. The altered gene replaces the normal gene so that a specific mutation is passed on from generation to generation.

Yet there are limits. Since yeast is a one-celled creature, it doesn't have different cells for skin, blood, liver, brain, and so on. Thus, yeast won't imitate problems of specialized cells—such as arthritis and muscular dystrophy.

### Ground Up and Boiled

The key to understanding how cells work is to find out how genes make proteins and how these proteins function in cells. "We can isolate all kinds of genes in humans and still not know what they do," says David Botstein of MIT and Genentech. "But if you can find an analog in yeast, you can destroy that gene and





Since the lowly yeast has the same basic design as human cells, scientists study it to learn more about how our own bodies work.

see what the consequences are. That tells us the function."

Through such "wreck and check" experiments, yeast researchers have learned about the role of the protein tubulin, the main ingredient in the filament-like structures that pull chromosomes apart when a cell divides. Tubulin is present in all eukaryotic cells, but it's more easily studied in yeast, with 3 genes for the protein, than in human cells, which have 20.

MIT geneticist Clarence Chan is examining other proteins that control chromosome segregation. To identify the genes that synthesize these proteins, he bathes yeast in chemicals that attack cells randomly, battering their DNA. He then looks for cells in which the segregation process is impaired. He has discovered six genes, other than those for tubulin, that are essential for this process.

Chan's colleague Ken Wertman is attempting to link mutant genes with inherited abnormalities. Employing a standard technique called tetrad analysis, he

mates different yeast strains carrying these mutants and induces meiosis, a division process that occurs when a cell is deprived of nutrients. He then studies the progeny. Wertman says his work is similar to the search for human genes that are associated with certain disorders. Except that "with yeast, you can pick the 'parents' and mate them at will," he points out. "The 'children' can be analyzed in detail—ground up, boiled, anything you want." His work has uncovered a protein needed for the synthesis of cell membranes.

Brandeis University biologist Jim Haber is looking at yeast cells undergoing mitosis, the more normal type of cell division. Genetically programmed rearrangements that occur during mitosis resemble the reorganization of DNA in human immune cells, Haber says. In the "worst case" scenario—when inappropriate pieces of DNA join together in the immune system—the result can be leukemia or lymphoma.

Through yeast experiments, scientists are gaining

insight into how complex organisms with specialized cells can evolve from a single cell, the fertilized egg. Although it doesn't have separate cells for the brain and liver, yeast does come in three types.

"A yeast cell starts out as a sphere, yet it has a 'front' and a 'back,' just like animals do," says MIT biologist Frank Solomon. This asymmetry appears during mitosis. "But what is the origin of that asymmetry, and how is that decision made?" No one knows precisely, but it involves actin. Somehow, actin filaments align to point to the spot where a bud will form and start a new cell. In both yeast and in humans, the differences stem from regulatory proteins, Herskowitz explains. "These proteins bind to specific genes and say, 'you are on, and you are off.'"

However, he adds, "why do liver cells produce a particular protein, and not brain cells? In other words, what regulates the regulatory protein? That is completely unknown." ■

STEVE NADIS is a regular contributor to Trends.

## Pollution Indoors

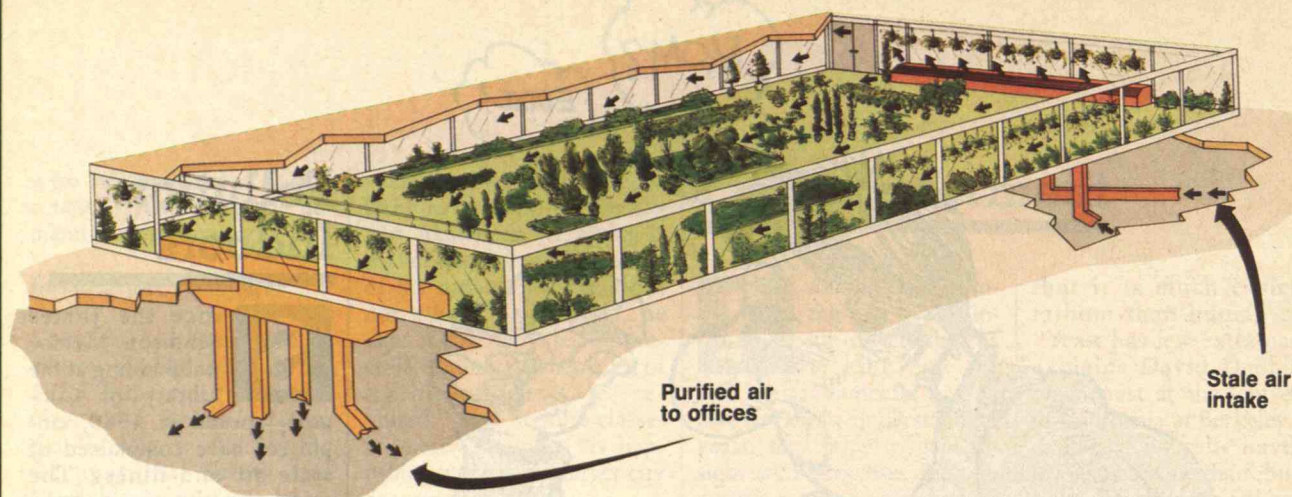
**S**ince the James Madison Memorial Building at the Library of Congress opened in 1980, employees have complained of stale air and illness. The search for the cause of the complaints has failed to produce remedies. Last year, the National Institute for Occupational Safety and Health, the Environmental Protection Agency (EPA), the Department of Energy, and several other public and private agencies teamed up to use the building as a laboratory to study indoor air pollution.

That effort exemplifies the attention indoor air pollution is beginning to receive. However, a lack of explicit standards or guiding legislation is slowing progress, even as researchers propose innovative preventive measures, including cooking buildings.

California is experimenting with "bake out," which forces furniture and construction materials to release toxic gases before tenants move in. In one test, John Girman, deputy manager of California's Indoor Air Quality Program, heated a new county building to 100°F for three and a half days. A day later, the level of unwanted gases had declined 40 percent. A month later, they were 6 percent of the original level. California's state architect recommends bake out for major new public buildings, although Girman wants further tests. Among other possible drawbacks, baking might damage wood or inadvertently set off water sprinklers.

Even NASA is seeking answers, since astronauts in sealed capsules face many of





the same problems as office workers. Researchers at the John Stennis Space Center in Mississippi have discovered that common houseplants—including spider plants, aloe vera, and philodendron—can reduce the levels of formaldehyde, benzene, and carbon monoxide. Principal investigator Bill Wolverton estimates that 15 spider plants could remove the formaldehyde emissions from furniture, walls, and cooking in the average home.

For the time being, Kevin Teichman, a coordinator for EPA's indoor air pollution program, suggests two steps: controlling the sources of contamination and increasing the flow of air. Reducing sources can be as simple as cleaning a soiled air filter or carpet, and one of the largest sources—cigarette smoke—is a prime target for corrective actions. In a Centers for Disease Control survey, 42 percent of workplaces restricted smoking; 3 percent banned it.

Increasing ventilation, often the simplest step, isn't always effective. Ventilation systems are notoriously difficult to adjust. Merely turning up air flow isn't enough, since pollution often originates in the ventilation system itself.

#### State Leadership

On the regulatory front, state governments are the leaders

in the absence of a comprehensive federal approach. Every state has some relevant program, with most covering well-established contaminants such as asbestos or tobacco. Nearly a dozen states have active indoor air quality programs, led by New Hampshire and Maine, which enforce standards for new state buildings. Pressure from the Service Employees International Union, which represents many public employees, prompted both states to act last year.

At the federal level, no agency has explicit authority over indoor air pollution. The Occupational Safety and Health Administration protects workers' health but has focused on factories rather than offices. The Consumer Product Safety Commission works with industries, such as humidifier manufacturers, to establish voluntary standards. And EPA has interpreted its pollution-control mandate to apply to the outside atmosphere.

The American Society for Heating, Refrigerating, and Air-Conditioning En-

gineers (ASHRAE) issues the closest thing to nationwide standards. State and local governments use ASHRAE recommendations as a model for building codes, which dictate the design but not the use of ventilation systems.

ASHRAE first codified ventilation rates in 1973 to control body odor and tobacco smoke. In 1981, it recommended additional ventilation for smoking areas and established maximum levels for formaldehyde and several other common pollutants. But the 1981 standard wasn't widely accepted, partly because of opposition from the tobacco and formaldehyde industry associations—both ASHRAE members.

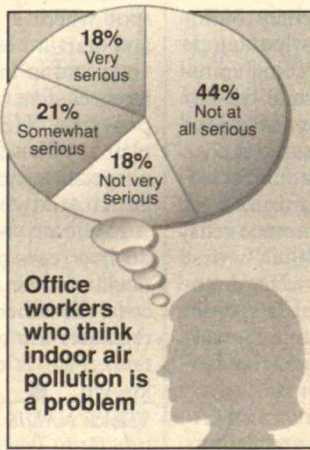
In 1986, however, EPA initiated a small indoor air program, assigning one employee to it. Today, with a budget of \$350,000, the program has risen to the division level and has a staff of six. Says the division director Robert Axelrad, "I'm preparing to lay the groundwork for when we are given a specific direction." To provide such direction,

**A rooftop full of plants might be able to purify and revitalize the air inside energy-efficient buildings.**

Sen. George Mitchell (D-Maine), then chair of the Environmental Protection Subcommittee, introduced an Indoor Air Quality Act in 1987. The bill passed the Senate but didn't come to a House vote that year. To be reintroduced this year, it would authorize nearly \$50 million for research, demonstration projects, and education. And it calls for EPA to develop a plan for eliminating indoor air pollution using existing authority.

EPA employees will welcome another clause: the agency's new headquarters would be a model to "demonstrate principles and practices for protection of indoor air quality." After EPA carpeted its current home in late 1987, over 70 employees suffered burning eyes, respiratory irritation, mental confusion, breathing difficulties, and a variety of other symptoms. EPA's emergency response team, formed to tackle chemical spills and toxic dumps, detected traces of over 50 chemicals typically found in industrial workplaces and hazardous-waste sites. ■

DANIEL GROSSMAN is a frequent contributor to Trends.





## Foundation for a Small Planet

**T**hose who bemoan the increasing specialization and fragmentation of science will be cheered by the advent of the International Foundation for the Survival and Development of Humanity. As the lofty name intimates, this body's scope is broad and its challenge great.

Conceived and launched on a grand scale, the foundation will fund innovative, collaborative, and interdisciplinary projects that address global problems. Its four committees reflect the organization's interest in human rights, international security, international development and the environment, and education and culture.

The foundation is the brainchild of Yevgenii Velikhov, vice-president of the Soviet Academy of Sciences, and Jerome Wiesner, president emeritus of MIT and science advisor to presidents Kennedy and Johnson. These prominent scientists proposed the institution in Moscow in 1987. Within a year, the foundation became the first international, non-profit, non-governmental organization to gain legal status in the Soviet Union.

According to Wiesner, the group first had to overcome Soviet unfamiliarity with the "strange American idea" of a foundation—"people make a lot of money and then establish a foundation to figure out how to spend it." But, says Velikhov, questions of the environment, disarmament, and the biosphere "do not belong to any one country," and the idea quickly won the support

of Soviet Premier Mikhail Gorbachev.

Although it has already received several hundred proposals, the foundation will probably not fund projects regularly until 1990. In the meantime, foundation staff regret that most proposals suggest only in-depth examinations. "What we are really looking for are ideas for answers that can be put into action," says William Miller, director of the U.S. office.

So far, the board has initiated international workshops and working groups in each of the foundation's areas of concern. A recent session drew together scientists and government officials from a number of nations to look at tactics to prevent the environmental degradation of the Baltic Sea. At another workshop, arms experts focused on methods to prevent the accidental launch of nuclear weapons. Future sessions will discuss possible international collaborations on global-warming issues and civil,

penal, and emigration rights.

Based on the initial enthusiasm of board members, the foundation could become more than "a grant-making organ," says Miller. Many board members see the foundation as a forum on the subjects that make up its agenda. Miller suggests that this stems from the group's "remarkable access to world leadership."

In fact, the fledgling institution has compiled a prestigious roster of luminaries. Board members include former United Nations assistant secretary general Rolf Bjoernerstedt, Sao Paulo University president José Goldemberg, and, from the corporate world, Apple Computer president John Sculley and Armand Hammer, president of Occidental Petroleum and well-known advocate of closer U.S.-Soviet relations.

The foundation is off to an auspicious start. For the U.S. announcement of its inauguration, it orchestrated the first visit to the West of dissident Soviet physicist—and foun-

**Jerome Wiesner (left) and Yevgenii Velikhov (center) proposed the U.S.-Soviet foundation that arranged for Andrei Sakharov (right) to visit the West for the first time.**

dation board member—Andrei Sakharov. That trip resulted directly from the organization's existence, since Soviet laws had to be amended to ensure that board members could attend all foundation meetings.

From 1980 until recently, Sakharov had been banished to the closed city of Gorky because he had called for the withdrawal of Soviet troops from Afghanistan. The prospect of his leaving the Soviet Union apparently faced stiff opposition at a special meeting of the Council of Ministers. But Soviet foundation members put their feet down: "We refused to come without him," Velikhov told the *New York Times*.

In his first remarks in the West, Sakharov reiterated the urgent need to confront "the global problems now standing in front of humanity." Miller echoes those sentiments, saying the desire to stave off a "shared apocalyptic vision" is a "unique characteristic" of the foundation.





However, the agenda is daunting, and Miller acknowledges that the "logistical administrative difficulties have been enormous." In particular, this international effort couldn't seek funds in earnest until its status in the Soviet Union was certain.

Ultimately, the group plans to raise \$10 million a year from private sources. As a start, Hammer pledged \$1 million, and several U.S. foundations have promised hundreds of thousands of dollars to pay for initial operating expenses.

In the Soviet Union, money will come from the Soviet Peace Fund and from unspent small donations to the Chernobyl Fund, which was established to assist victims of the accident at that reactor. Initial Soviet contributions should total several million

dollars. The foundation is also benefitting from the sale in the Soviet Union of a rock-and-roll record featuring U.S. and British bands. Board member David McTaggart, president of Greenpeace International, suggested this novel scheme.

To date, the foundation has opened offices in Moscow, Stockholm, San Francisco, and Washington, D.C. It plans to eventually operate at numerous locations around the world. In the Soviet Union, the task of housing the organization set yet another precedent: with funds from Armand Hammer, it purchased a state-owned building in Moscow. ■

*SETH SHULMAN, a regular contributor to Trends, also writes for Nature and other publications.*

## States, Technology, and Jobs

**I**n the 1980s, states have put a new twist on economic development. To spur innovation, nearly all have sponsored partnerships of government, industry, and universities. The aim is to catalyze corporate-academic relationships that will revitalize industry and create jobs.

Broad state attempts to develop and capitalize on technology began in 1982, when Richard Thornburgh, then governor of Pennsylvania, proposed the Ben Franklin Partnership program of applied-research grants, with industry and the state sharing the bill for university studies. "There was widespread recognition that something was fundamentally wrong" with existing state development strategies, says Christopher Coburn, director of Ohio's Thomas Edison program.

Ohio, Michigan, and other Rust Belt states quickly followed Pennsylvania's lead. By 1988, the Minnesota Office of Science and Technology counted 44 state technology programs that together spent \$550 million a year, with 10 states accounting for \$364 million. Two-thirds of the money supported applied research, and the rest was spent on small-business incubators and other measures to help companies bring technology to market.

At the heart of most programs are research centers, often called advanced technology centers or centers of excellence. Those in Ohio, New Jersey, and New York, among others, engage in a broad range of activities, which companies support through annual subscription fees. The subscribers receive influence over research pro-

grams and inside information about progress and results. Other centers, as in Pennsylvania, act as matchmakers between companies and university research, sweetening the pot with state money.

The state programs account for less than 1 percent of the nation's annual \$130 billion R&D bill, but that sum may be significant. "If you are willing to invest strategically, with a small amount of money, [the state] can affect larger investments by larger organizations," says Coburn. Requiring industry to share the R&D costs is one way to enforce such leverage.

Ohio State University vice-president for research Jack Hollander points to another benefit of state sponsorship of the Thomas Edison research centers. He believes that as academics and business people have knocked heads over R&D priorities in these "shotgun marriages," they have gained mutual respect and understanding. "The families are not always happy, but they are at least sitting together at the same dinner table."

Federal actions could conflict with state initiatives, however. H. Graham Jones, director of New York's Science and Technology Foundation, notes that the National Science Foundation (NSF) put a telecommunications research center in New York City, where the state already had such a project. Since then, NSF and other agencies have tried to ensure that programs dovetail. A recent NSF agreement to tell states about university proposals for its centers should help, he thinks.

Still, documenting success is difficult. Even if a program



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**A grant from Ohio's Edison program could lead to a marketable, low-cost additive that would give animal feed more vitamins and a better mix of amino acids.**



improves the climate for innovation, benefits are hard to prove by the traditional criterion of economic development—jobs created or saved. Indirect indicators, such as increased industry R&D, may not convince legislators that public money is well spent.

Coburn points out that no state program is even halfway through the 15 years that it takes to produce major pay-offs on innovation. Meanwhile, "How to demonstrate an adequate return on taxpayer dollars is the biggest and hardest challenge."

Complicating the question is the fact that the timetables of the centers vary widely. New Jersey, New York, California, Texas, and other states take a long view, funding cutting-edge research. At the Ben Franklin Partnership, emphasizing shorter-term product-oriented research, di-

rector Jacques Koppel says the yardstick is "how many jobs will be created . . . over the next two to five years." But job creation is hard to quantify. A 1988 legislative audit said the partnership's claim to have yielded more than 10,000 jobs was insufficiently substantiated.

Officials and analysts generally agree that R&D's role in generating jobs is complex. Penn State economist Irwin Feller believes that changing attitudes and practices at universities and companies, which "lower the cost of collaboration," may be the most important contributions. Tying success too tightly to job creation can be dangerous, he adds.

In other words, legislators need a degree of faith. In fact, the programs have passed their first political tests. The Ben Franklin Partnership re-

ceived \$28.7 million from the state this year, up from \$21.3 million two years ago, and its enabling legislation has been extended for 10 years. Ohio's Edison centers, scheduled to become entirely reliant on industry by 1988, received a two-year reprieve and are seeking further state funding. And New York's assembly, dealing with a large budget deficit, has continued to back the Science and Technology Foundation.

"The question is what happens to support in a recession," says John Crosbie, associate director for legislative affairs of the New Jersey Commission on Science and Technology. Many programs "remain to be tested," he observes. ■

*DUNCAN BROWN is a freelance writer based in Washington, D.C.*

## Intergalactic Diplomacy

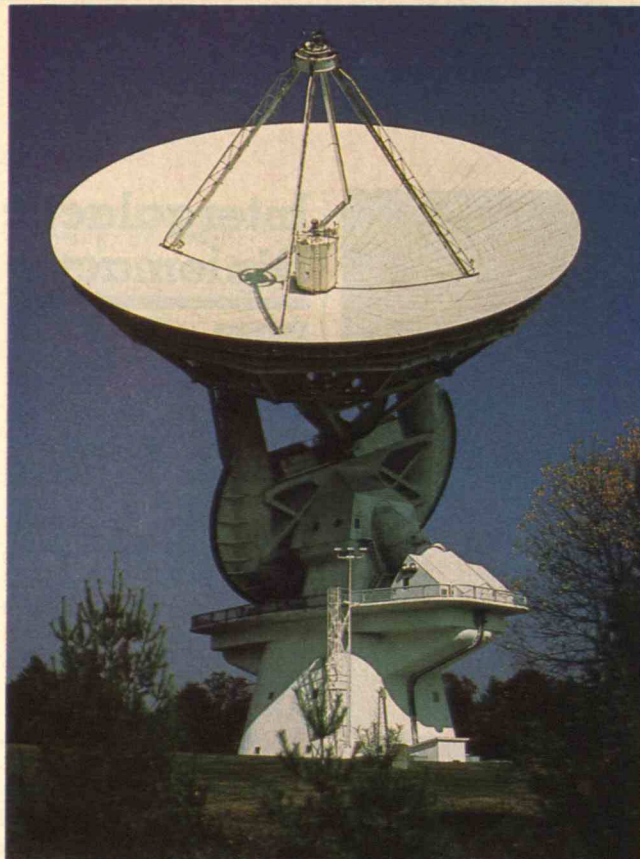
**W**hat should astronomers do if they detect what might be a message from intelligent beings from outer space? Who should they tell first?

Principles of scientific openness should guide all responses to outer-space signals, according to an international group that includes a space lawyer, astronomers, and the director of the U.S. State Department's Office of Advanced Technology. After four years of debate, the group formally presented an international protocol for such occasions at an International Astronomical Congress meeting in Bangalore, India, in October 1988.

"Search for extraterrestrial intelligence" (SETI) projects assume that coherent radio signals from outer space must be either beacons from civilizations wishing to attract attention or unplanned evidence of technical competence. But SETI astronomers have long worried that some officials might see a potential for political or technological gain in being the first to reply to aliens. Such politicians might try to keep discoveries of incoming signals secret. Messages would also need decoding, and bringing in professional code-breakers could enmesh the response to extraterrestrials in the world of espionage.

Georgetown University law professor Allan Goodman has argued since 1984 for international rules of conduct to keep SETI signal analysis from becoming a political football. Peter Boyce, executive director of the American Astronomical Society, adds,





The formal search for intelligent extraterrestrial life began in 1960 at this radio observatory in Greenbank, W. Va.

"We want to circumvent political fiat" that would prevent a discovery from reaching the global scientific community. Both Boyce and Goodman are among the authors of the report.

Scientists have also been concerned that unverified alerts might panic the public. News of a SETI event might lead to embarrassment as well, because the signals could turn out to have a less-than-glamorous origin.

In fact, since the first formal SETI searches began in 1960 at the National Radio Astronomy Observatory at Greenbank, W. Va., a number of "false positives" have been reported. These anomalies have appeared so unique that an alien civilization has seemed the only explanation. Perhaps the most famous example is a strong signal recorded in 1977 at Ohio State University. A team member wrote "wow" next to his notes, lending that name to such phenomena. The Ohio State wow never reappeared.

Boyce appends a related problem. "We need a breathing spell to avoid being duped by Caltech undergraduates," he says. Those students have made a name for themselves by perpetrating hoaxes.

#### Verify and Trust

The proposal addresses verification issues first. Those who discover a signal would strive to eliminate the possibility that a natural or human source emitted it. If they succeeded, they would notify national authorities such as NASA that something significant had been found. They would also inform research organizations that sign the treaty, who would attempt to independently confirm the finding or provide an alternate explanation.

If the scientists at these organizations agree that some extraterrestrial intelligence is the likely source of the signal, they would notify the astronomical community at large, the United Nations, and

space-law bodies, such as the International Union of Space Law in Paris. Only after this would the discoverers go public with their finding, assuming the secret had not leaked out already.

While secrecy is necessary during the verification process, the protocol places a high priority on ensuring open access to SETI information. The protocol would bind signatories to record and permanently store all data relating to a signal. Moreover, researchers would make data generally available in a variety of formats.

Because replying is a political act, the protocol adds that no single nation should control the answer. It states that "no response to a signal or other evidence of extraterrestrial intelligence will be sent until appropriate international consultations have taken place." Specifically, the accord looks to a proposal presented at a 1987 meeting of the Congress of the International Astronomical Federation, which suggests making all responses on behalf of humanity as a whole. And any communication to outer space must be peaceful, truthful, and express tolerance of differences.

Over the next four years, a number of scientific and space-law bodies will consider the Bangalore proposal. The authors hope to present it to the United Nations before Columbus Day 1992. On that date, NASA hopes to begin a \$90 million SETI program that will sweep the skies looking for wow indicators from all directions, as well as radio signals from the 1,000 closest sun-type stars. ■

STEPHEN STRAUSS, a regular contributor to *Trends*, is a science reporter for the *Toronto Globe and Mail*.

## MARS MISSION

When the Soviet *Phobos 2* spacecraft orbited Mars on January 25, 1989, it carried instruments and experiments designed by scientists from more than a dozen countries. Several University of Michigan engineers are among the U.S. experts sponsored by NASA as co-investigators for the mission. "Phobos is a pathfinder showing how nations can cooperate in space research," says Andrew Nagy, professor of atmospheric and oceanic science.

"The Phobos mission represented the first major direct participation by American scientists in a Soviet space mission," Nagy notes. Working with the Hungarian Central Research Institute of Physics, he and his colleagues designed, constructed, and calibrated an instrument to measure charged particles that are produced when solar wind interacts with the Martian atmosphere. Nagy's colleague Sushil Atreya is a co-investigator with France's National Space Agency on an experiment to measure the distribution of ozone and water vapor in the atmosphere of Mars.



## DIOXIN IN MILK

According to U.S. paper industry tests, milk cartons contain dioxin. And a recent study by Canada's Health and Welfare Branch has



shown that dioxin migrates from the carton into the milk.

As a result, Greenpeace U.S.A. is petitioning the U.S. Department of Agriculture, which subsidizes the school lunch program, to ensure that milk provided to children is not contaminated with dioxin from the carton.

Dioxin is a by-product of chlorine bleaching processes used to whiten paper products. Sweden and some other European countries are either leaving cartons unbleached or switching to environmentally safe oxygen bleaching.

## TRUCK SAVINGS

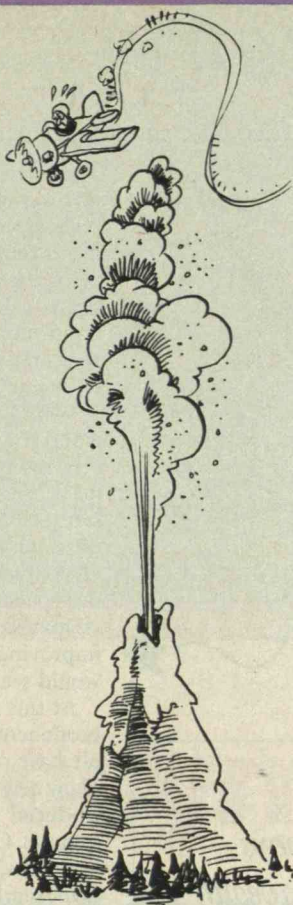
U.S. big-rig trucks could save up to a billion gallons of fuel with aerodynamic boat-tails. Developed with a National Science Foundation small-business grant, engineers recently tested the equipment on a full-size tractor-trailer rig in the NASA-Ames wind tunnel, the world's largest.

Fins attached to the rear end of a truck cause air flowing over the tops and sides of the trailer to turn inward at the back. This creates a smoother, boat-tail-shaped flow. Drag on the truck is reduced 10 percent.

## VOLCANO WATCH

A new volcano-watch service will alert pilots when eruptions cause dangerous ash clouds along domestic and international flight routes. Major eruptions can create vast ash plumes, which high-altitude winds carry around the earth. An eruption at Galunggung in Indonesia caused engines on two 747s to shut down when glassy coatings covered hot moving parts.

The National Oceanic and Atmospheric Administration (NOAA) will use its weather satellites and other meteorological



logical techniques to watch for eruptions. When a volcano spews debris above about three miles, NOAA will give the Federal Aviation Administration data on the location, height, and movement of ash clouds.

## ONE BILLION, PLUS

Chinese and U.S. technicians worked together to make China's first computerized census a reality. After the Chinese government amassed over 1 billion records, it lacked the technology to write programs that could derive meaningful information from that database. In 1986, it turned to a product called UFO from New Jersey-based On-Line Software.

Although it took many person-years to create the UFO system, which *Computerworld* has nominated for an innovation award, relatively little time was needed to in-

stall it in China and train technicians. Now the State Economic Information Center writes UFO applications whenever authorized government officials desire more information.

## DISASTER STRESS

Technological disasters such as Love Canal and Three Mile Island present special social problems for individuals and local officials. According to Penn State sociologists Stephen Robert Couch and J. Stephen Kroll-Smith, "the community does not have experience with these disasters and therefore does not know how to respond, on a personal or governmental level."

While natural disasters often bring people together, technological disasters can "alter social structures or destroy communities completely." The difference is that technological disasters can frequently be attributed to specific people or groups.

The sociologists have been studying Centralia, Pa., where a mine fire has been burning underground for decades. Conflicts between different factions of the community have been the most debilitating outcome, causing more stress than the health effects of the fire.

## RESTORING ELLIS

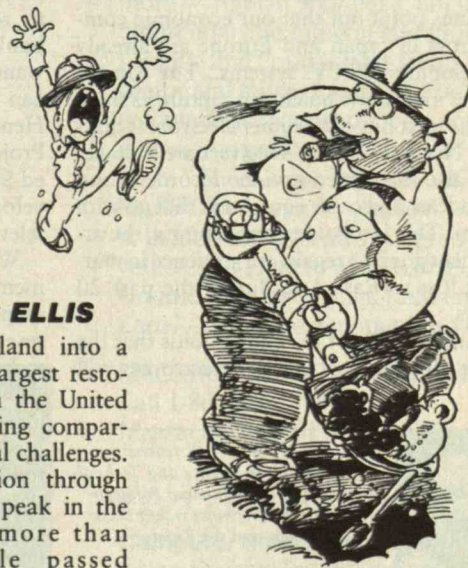
Turning Ellis Island into a museum is the largest restoration project in the United States, representing comparable technological challenges. When immigration through Ellis was at its peak in the early 1900s, more than 10,000 people passed

through the main building every day.

The National Park Service and the Statue of Liberty/Ellis Island Foundation stipulate "that all components fit into the existing structure without disturbing or obtruding on its fabric," writes Cynthia Owen Philip in *Mechanical Engineering*. And every shovelful of earth must be "carefully scrutinized for artifacts by an archaeologist empowered to stop work."

Engineers are salvaging ceilings, walls, skylights, radiators, toilets, and lighting fixtures from the main building, whose powerhouse looks just as it did in 1900. New equipment has been hoisted through the roof to preserve old walls, doors, and windows. A rebuilt chimney has five stainless-steel flues but matches the original.

The Great Hall, where medical and legal examinations took place, will be heated by the original radiators. These have been cleaned, sand-blasted, and repainted with banana oil and aluminum-colored bronze powder, materials used at the time.





## Who Needs HDTV?

Imagine a list of the hundred most urgent needs our society faces. Housing the homeless, caring for the elderly, protecting the environment, providing better education for our children, rebuilding the crumbling infrastructure of our highways and bridges—an inventory of this kind could grow indefinitely. And the cost of solving the most pressing of these problems could run into hundreds of billions of dollars.

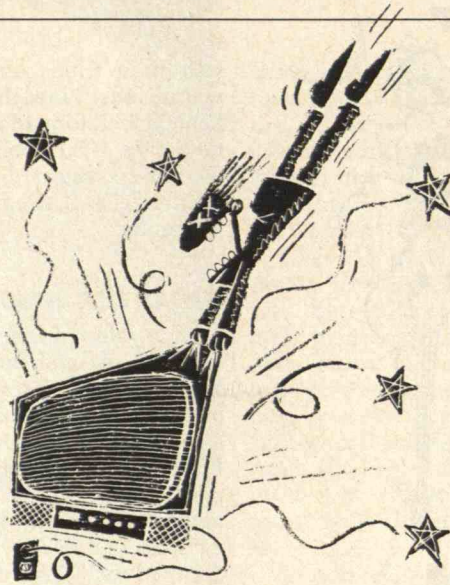
By the way, did you remember to include the following crucial item: improving the quality of your television picture? Probably not. No reasonable person's sense of how to spend our society's scarce resources would include such a frivolous item. The sharpness of TV images does not appear to be a serious personal or social worry for any significant portion of the U.S. population.

But, my friends, get ready. Concerted efforts are already under way to convince us that improving the television picture is a grave national priority. The American public is being asked to devote tens of millions of dollars to R&D and billions to consumer spending on "high-definition television" or HDTV, a technology that replaces the 525 horizontal lines of current television receivers with 1,000 to 1,250 lines.

HDTV is a classic case of a technological imperative in the making. Powerful institutions push a technology even though it meets no perceived social need. If you doubt that there is any such thing as "technological inevitability," just sit back and watch the coming of HDTV.

The arguments for developing HDTV echo other recent high-tech promotions. Advocates point out that our economic competitors in Japan and Europe are already developing HDTV systems. The United States must move quickly to capture its share of the next huge consumer electronics market. Not only HDTV receivers are at stake, but also the cameras, video recorders, and broadcast and cable equipment that go with them. This is a golden opportunity, the argument goes, to regain our presence in markets lost to East Asia during the past 20 years.

Another line of reasoning holds that the next generation of warfare electronics will



*There  
are better ways  
to invest U.S. wealth  
and technical ingenuity  
than in improving  
TV images.*

require the kinds of high-quality visual displays that HDTV offers. As video sets come to resemble small computers filled with banks of microelectronic chips, the military wants to make sure that American producers can supply the equipment it will require. Hence, the Defense Advanced Research Projects Agency (DARPA) recently budgeted \$30 million to support research and development on, of all things, improved television.

What's striking about pro-HDTV arguments is the emphasis they place on the need of powerful organizations—corporations, research institutions, the military—for the technology. Remarkably little is said about what genuine social need it might fill—let alone whether people actually want it. The assumption seems to be that citizens can be induced to embrace whatever new technology powerful decision makers tell them to.

Common estimates of the costs for adapting to HDTV add up to hundreds of billions of dollars over the next three or four decades.

The public is being asked not only to subsidize this development but also to approve a relaxation of antitrust laws to allow new multicompany manufacturing consortia—i.e., national monopolies. This opportunity arrives at a time in which we are told there is no money for affordable housing, day care, or better salaries for high-school teachers.

What is so good on television that we need a 60-inch, theater-quality screen with digital stereophonic sound blaring at us? Do we need a better image of the graying hair of the stars on "Dallas"? Clearer shots of the blood on football players' jerseys? A more intimate view of Morton Downey's toothy snarl? If our society absolutely must spend billions on television during the next several decades, improving the quality of programming would seem a better place to start.

At this point in the discussion, HDTV proponents usually note that ordinary people have responded enthusiastically to the many new kinds of consumer electronics introduced in recent years—VCRs, video cameras, CD players, and the like. "The market works," they conclude, "so bring HDTV to the market and the consumer will decide." But is the market the only mechanism for determining what we want or need? Is there no other way of saying yes or no to what is sure to be an enormous social expenditure?

A possible alternative would be to set up some innovative experiments and public debates on the question, Do most television viewers really care about having a better picture? Perhaps the congressional Office of Technology Assessment could set up demonstrations in community centers and shopping malls, asking passersby to compare current TV with the high-definition prototypes, to hear the pros and cons—including HDTV's costs and likely consequences—and to register their preferences. My guess is that confronted directly with a choice of this kind, most people would respond with a grand "Ho hum."

I for one hope HDTV will go the way of quadraphonic sound, automobile tail fins, picture phones, wankel engines, talking dashboards, and other innovations of questionable merit. There are far better ways to invest our society's wealth and technical ingenuity. At the same time, I recognize that we live in an era in which technological innovation and genuine human needs frequently part company. In this instance, it's going to take a barrage of clever advertising and media hype to convince us that our interests are well served by HDTV. ■



LANGDON WINNER teaches in the Program on Science and Technology Studies at Rennselaer Polytechnic Institute. His most recent book is *The Whale and the Reactor*.



$$\text{forced case: } y'' + y + \varepsilon y^3 = \varepsilon \delta \cos(t) \\ y \sim \frac{36}{3} \delta \cos(t) + \frac{\varepsilon \delta}{72} (-\cos(t) + 3 \cos(3t)) + \dots$$

control pitch thru  $\vec{u}: \vec{y}' = A\vec{y} + B\vec{u}$

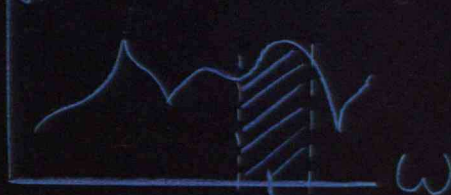
$$TFM_{1,1} = \frac{\alpha}{s^3 - 2s^2 + s - 2\alpha}$$

$$\left[ \text{Matrix} \cdot t \right]_{1,2} = \frac{6e^{5/2 t}}{\sqrt{33}} \sinh\left(\frac{\sqrt{33}}{2} t\right) \text{ from Macsyma}$$

$$-Pr((V^2)^2 + \sin^2(\Theta)(V^{3k})) + \frac{\partial P}{\partial r} + PV'(\frac{2V'}{r} + V^2 \cot(\Theta))$$

$$+V'(\frac{V'}{\partial r} + V^2 \frac{\partial P}{\partial \Theta} + V^3 \frac{\partial P}{\partial \varphi}) + \text{VISCOUS TERMS}$$

|TFM<sub>ij</sub>|



$$\text{Fourier}[\sin(t)] \rightarrow \frac{2}{\pi} \left( 1 - \sum_{n=1}^{\infty} \frac{(1+(-1)^n) \cos(nt)}{n^2 - 1} \right)$$

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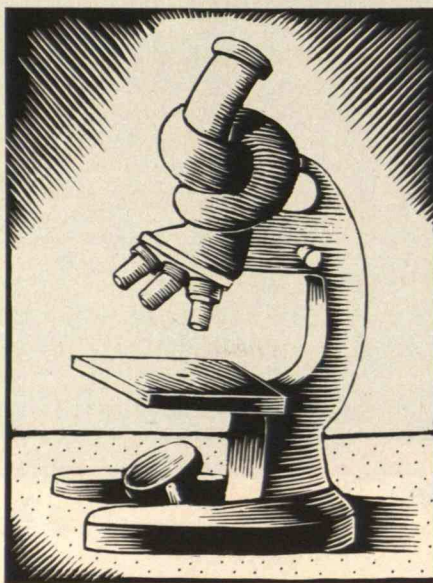
## The Worsening Climate for Biological Research

University research biologists make real sacrifices in choosing their profession. They train for 6 to 10 years beyond their bachelor's degree, often at minimal wages. Then, teaching at even the most prestigious universities, they generally earn less than they could as M.D.s in private practice or as researchers at commercial biotech companies. Not to mention that research science is a chancy occupation, involving continual applications for new grants, protracted negotiations with journal editors to get work into print, and of course the vagaries of the battle to understand nature's mysteries.

And yet, during much of the post-World War II era, biological research attracted some of our smartest young people. They found it intellectually stimulating and hoped to help solve the world's health problems. Universities and government provided grants for graduate education. Congress increased research funds year after year. Newspapers highlighted advances and hailed these scientists as the founders of a new industry, biotechnology. With the public cheering from the sidelines and the intrinsic gratifications of research, it all seemed worthwhile.

Recently, however, some vocal opponents have been sending research biologists a different message. Animal-rights activists are questioning the legitimacy of a vital component of the research enterprise—the use of experimental animals. Other organizations such as Jeremy Rifkin's Foundation on Economic Trends devote themselves to hampering the use of research biology's most powerful tool, the ability to manipulate and recombine DNA molecules, or to blocking a project to characterize the human genome.

Many in Congress are investigating the biological research community, the effect of which is to create a climate of doubt about the morality of the scientific mission. I have experienced this legislative scrutiny myself over a scientific paper I coauthored in *Cell* magazine. Support from my scientific colleagues has been unwavering, but many others have rushed to pronounce me and my coauthors guilty of charges never made and questioned our motives in the most inflam-



*Is the public  
losing faith  
in science?*

matory language. I don't believe this reaction has anything to do with our work, but it is typical of the resentment that many have begun to feel toward science.

Last January, Stanford president Donald Kennedy told the the American Association for the Advancement of Science that "a new and corrosive popular mistrust of scientists and their work" is generating "political constraints that are already cutting the growth of our science, cutting into its capacity to help us resolve our . . . problems." What are the sources of this popular mistrust and what should research scientists do about it?

### The Widening Gulf

The new critical attitude stems partly from a society-wide skepticism about intellectuals and their activities. The United States has entered an anti-intellectual phase in its history, perhaps most clearly seen in our virtually thought-free political life.

Such tendencies are exacerbated by the tremendous gulf between activities on the forefront of research and the public's understanding of them. As scientific literacy diminishes and research science moves on to

new frontiers, that gulf widens. Today there can be no real understanding among the general public of what research biologists are up to, because their activities are far removed from the everyday experience of most people.

An anti-intellectual atmosphere and widespread scientific illiteracy affect all researchers but are most dangerous for biologists, because they study life itself. People are threatened by the idea that scientists may develop the power to manipulate human life—for example, through advances in the understanding of human genetics. They see the prospect as an attack on their individuality. Although the research community's goal is only to understand and ameliorate inherited diseases such as cystic fibrosis, many people fear the wholesale transformation of the inherited characteristics of their children. That would be a frightening prospect, and scientists abhor it as much as anyone, but the confusion persists.

### Scientific Vietnam

Other reasons for public skepticism are more justified. One sphere where most Americans have enthusiastically supported basic research has been the health sciences. But research biology is still having only a minor effect on people's well-being. We have learned more about the nature of cancer in the last 15 years than in all of previous history, but we still have not been able to translate that knowledge into improved mortality statistics. In 1970, the U.S. government declared a war on cancer, and scientists see it as a winning battle. Seen from the public's perspective, however, it looks a bit like another Vietnam.

One final reason for public mistrust of research biologists is the fact that so many, both inside and outside the university, have become deeply involved in commercial activities. This trend has been encouraged by a public that wants to see new ideas translated into products. But as more academics have become wealthy, the air of purity that once surrounded basic science has become clouded by personal monetary considerations and a perception of conflicts of interest. For most scientists, basic research continues to be a relatively low-paying profession that requires deep dedication. But when some priests act like lords, the whole clergy becomes suspect.

All of these factors suggest that unalloyed support of the research enterprise is a thing of the past. In his address to the AAAS, Stan-

*Continued on page 24*



DAVID BALTIMORE, a Nobel laureate, is director of the Whitehead Institute for Biomedical Research and professor of biology at MIT.





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CONTINUED



ford's Kennedy urged scientists not to overemphasize the economic and health benefits of research. Such claims, he said, are too utilitarian and open the research community to charges of not delivering on its promises.

I disagree. It is too late to go back to arguing, as we did in the 1960s, that biological science is intrinsically valuable, whether or not it has economic and health benefits—not when many professors have become millionaires and the National Institutes of Health budget is over \$7 billion a year.

Instead, we need to be more receptive to the public's view of biologists. We should not deny the practical benefits of our science, but we should be careful to describe our work realistically, even conservatively. We must remember that there is a strong tendency in society to exaggerate scientific achievements,

fueled by the understandable desire of those who, for personal reasons, wish desperately for advances to become cures.

Nor should we pretend that some researchers don't make a great deal of money from successful research. Rather,

we need to emphasize how much society stands to gain in both personal and economic health. Major benefits for health will certainly come from contemporary biomedical research, even if they are not evident today.

Most important, we need to remind the public that research is done by smart young people attracted by the intellectual challenge and the freedom to use their talents fully. And like creative people in any field, they need breathing room to exercise their talents. If public opposition puts off young people who want to enter the research enterprise, we will all suffer. ■

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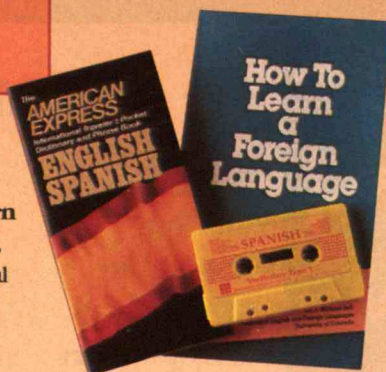
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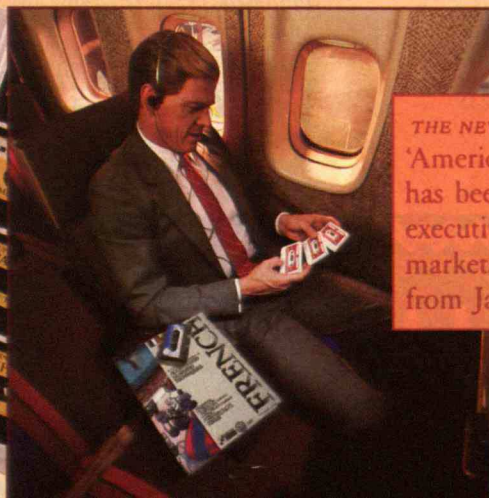
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**N**UCLEAR reactors have been orbiting the Earth since the 1960s. The Soviet Union has used them to power more than 30 Radar Ocean Reconnaissance Satellites (RORSATs). The United States is developing much more powerful space reactors designed primarily to power satellite components of the Strategic Defense Initiative (SDI).

Unshielded nuclear reactors provide the lightest, most compact, and most survivable long-lived sources of electricity for military satellites. But they also pose a danger to people on Earth. Two RORSATs have accidentally reentered the atmosphere and released their radioactivity, while last October a third, Cosmos 1900,

narrowly averted a similar fate. The time is ripe for pursuing a ban on orbiting reactors, before the United States and the Soviet Union test and deploy a more powerful—and much more radioactive—generation. Restricting their use could help prevent an arms race in space, further release of radioactive debris, and harm to astronomical satellites.

### **The New Generation**

Some 34 deactivated but still radioactive reactors now orbit the Earth, the first launched by the United States in 1965 and the remainder by the USSR. These units are expected to reenter the atmosphere in several hundred years, when their radioactivity will have greatly diminished. But a piece of orbiting space debris—quantities of which are growing rapidly—could disintegrate these reactors or knock them out of orbit long before then.

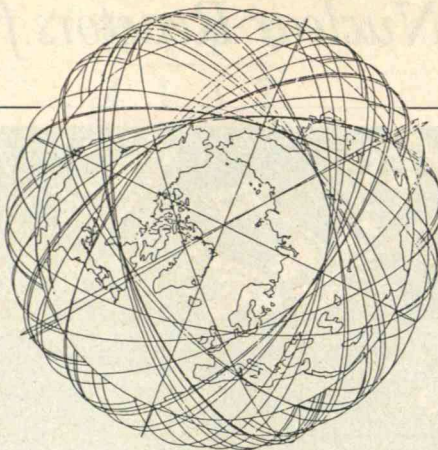
The next generation of orbiting reactors could pose an even greater problem. In 1987 the Soviets launched two units of a new design, about twice as powerful as the RORSAT reactors, into higher orbit. Meanwhile the U.S. government is spend-

*An agreement could prevent an arms race in space, eliminate a source of radioactive debris, and stop interference with astronomical satellites.*

JOEL R. PRIMACK is a professor of physics at the University of California at Santa Cruz who specializes in theoretical particle physics and cosmology. He represents a working group of the Federation of American Scientists and the Committee of Soviet Scientists for Peace and Against the Nuclear Threat. This spring the group is publishing several articles on orbiting nuclear reactors in *Science* and *Global Security*, a new journal with English and Russian editions and an editorial board composed of both U.S. and Soviet scientists.



**The lines around the globe show the relative positions of radioactive RORSAT reactors in "disposal orbits" in January 1986.**



ing more than \$100 million a year to develop the SP-100 reactor to power satellite battle stations. (The Department of Energy recently announced plans to build and ground-test a prototype SP-100 in Hanford, Wash., starting this year.) This unit, able to generate 100 kilowatts of electricity, will be about 25 times more powerful than the RORSAT reactors and is designed to operate 20 times longer. This means each unit would contain hundreds of times the long-lived radioactivity of a RORSAT. The SDI program has also begun to develop reactors capable of generating many megawatts of electricity for brief periods.

Of course, the SP-100 and more advanced reactor programs may not work as expected. A recent internal report by a team of experts from the Defense Department, Department of Energy, and NASA laboratories harshly criticized the engineering and management of the SP-100 program. And a National Research Council study concluded that multimegawatt reactors will probably be much too heavy for SDI satellites.

### Preventing Terrorism and Satellite Interference

Space-based reactors pose two added problems that a ban would help prevent. First, they are fueled with essentially pure uranium-235, the rare fissionable isotope that can be used to make nuclear weapons. The SP-100 design requires about 200 kilograms of uranium-235, many times the quantity needed to make a bomb. Accidental return of an intact reactor to Earth's surface, either during launch or from orbit, would therefore provide enough fuel to make a formidable nuclear arsenal.

An international race to recover uranium could ensue if a reactor were to fall back to Earth. Since reactors are not turned on until they reach orbit, a launch accident could provide nonradioactive nuclear materials that terrorists could convert to weapons. While the SDI Organization has proposed retrieving errant reactors or boosting them to higher orbit, a unit that has collided with another object or been attacked by an anti-satellite weapon might reenter before there is time to rescue it.

The 15 percent accident rate of the Soviet space-reactor program (including one or two launch failures) does not inspire

confidence. U.S. satellites powered by radioactive thermoelectric generators, in which materials such as plutonium-238 provide energy from heat without fission, have seen a comparable failure rate. This is particularly frightening considering the hundreds of reactor-powered battle stations that could be required for the later phases of SDI.

The second problem is that space reactors are intense sources of gamma rays and positrons (anti-electrons). These interfere with astronomers' readings of natural energetic radiation from phenomena such as solar flares, neutron stars, and black holes. The positrons from the reactors temporarily form an artificial radiation belt in Earth's magnetic field. When they strike another spacecraft, the positrons produce the penetrating gamma rays.

In 1987 and early 1988, such radiation from the new Soviet orbiting reactors frequently swamped the gamma-ray spectrometer on board the U.S. Solar Maximum Mission satellite. Other units, including the Japanese x-ray satellite *Ginga*, also suffered. Expanded use of space reactors could devastate the new, highly sensitive astronomical satellites soon to be launched, such as the U.S. Gamma-Ray Observatory.

### Both Sides Gain

Both sides stand to benefit from an agreement banning orbiting reactors, since it would be an obstacle to both SDI and deployment of more RORSATs.

A ban would help strengthen the Anti-Ballistic Missile (ABM) Treaty as well as eliminate a principal U.S. incentive to develop anti-satellite weapons (ASATs). This is because the Air Force wants to use ASATs to destroy RORSATs.

Today space reactors are essentially unregulated. The U.N. Committee on Peace-

ful Uses of Outer Space (COPUOS)—mainly concerned with environmental dangers—has discussed halting further use of reactors orbiting at an altitude of less than about 500 miles.

A better idea would be to ban all orbital reactors, since no nation is considering them for civilian uses for at least the next decade. Reactors could not be used as power sources for an orbiting space station, since they are such strong sources of radiation that human presence anywhere near them would be impossible. And providing shields thick enough to prevent this would make them too heavy to be practical. In fact, I know of no civilian use in Earth orbit that requires nuclear power.

A ban on reactors in orbit would not preclude using them in deep space. Reactors may be essential for powering ambitious unmanned spacecraft to explore the solar system's outer reaches, where solar energy is faint. Reactors may also be an appropriate source of power for a manned lunar base, since they would have considerably less mass than the solar-energy storage devices required by the 14-day lunar night. (A reactor designed to be implanted in the lunar soil for shielding would probably be quite different from the SP-100.)

To prevent either side from developing or testing a military space reactor under the guise of a civilian program, a 10-year ban on *all* space reactors might be appropriate. The United States and the Soviet Union might then be on good enough terms to allow orbital testing for deep-space missions. Removing the military link to space reactors may be the key that makes international missions possible.

Verifying a ban on orbiting reactors would be easy because they are a bright source of infrared radiation (the SP-100's heat radiators will operate at 980° Fahrenheit). Existing infrared telescopes on the ground or on airplanes could detect such a heat source instantly. Gamma-ray and positron emissions would also give space reactors away: astronomical equipment aboard spacecraft and balloons already recognize RORSATs and the new Soviet reactors.

Space is the largest arena for human endeavor, and one that is just beginning to be militarized and polluted. The world has long recognized that nuclear power must be regulated. The time is ripe for an agreement to ban nuclear reactors from orbit. ■





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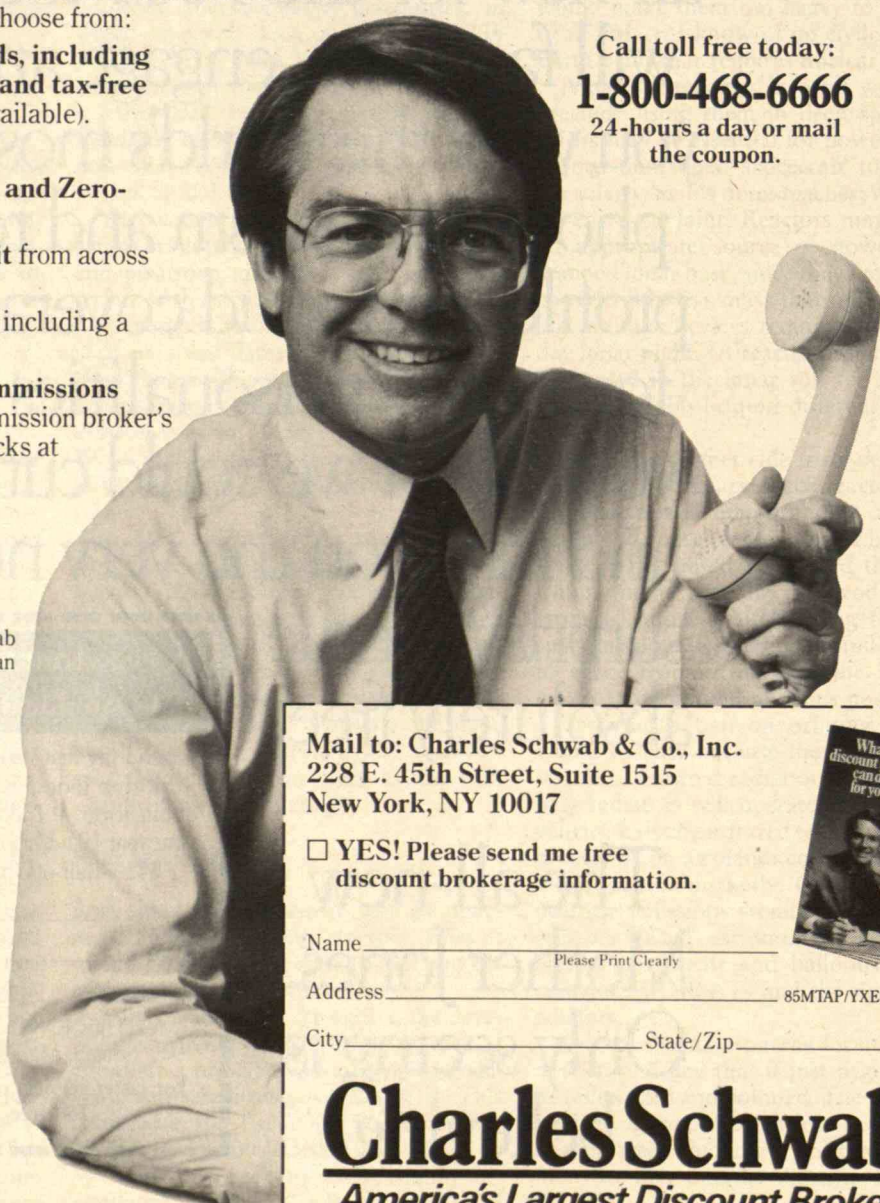
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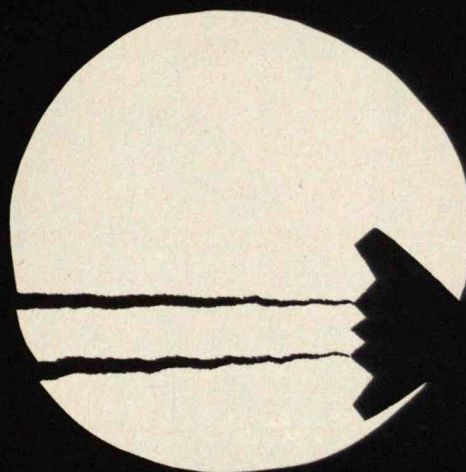
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# **STEALTH**

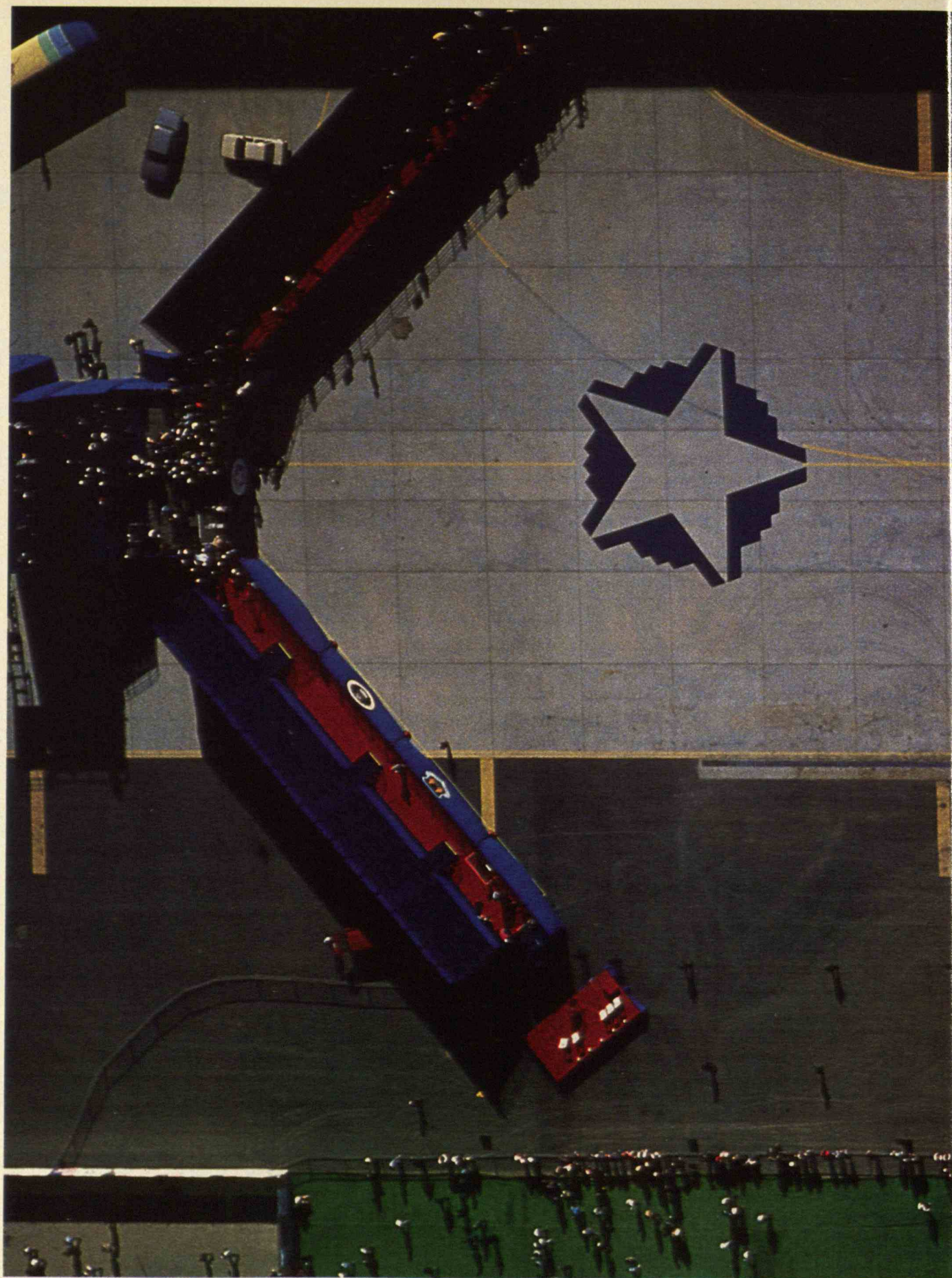
## **THE NEW APPROACH TO WEAPONS DESIGN**

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**W**ith the unveiling of the B-2 stealth bomber last November, the public got its first look at the results of a decade-long development effort by the U.S. Air Force. But the techniques of stealth, designed to foil enemy radar and other sensors, are not limited to the B-2. They are showing up on a variety of equipment, including fighters and missiles. In fact, they constitute the single largest U.S. defense R&D expenditure. In "The Technology of Stealth" (*page 32*), Jay H. Goldberg explains how advanced materials, engines, and body designs can make a vehicle harder to detect. He also looks at the tradeoffs that stealth entails in performance and cost. In "In Search of the Elusive Stealth Bomber" (*page 41*), Michael Brower addresses some big questions posed by the new technologies: can we afford them, and what do they mean for the strategic balance?

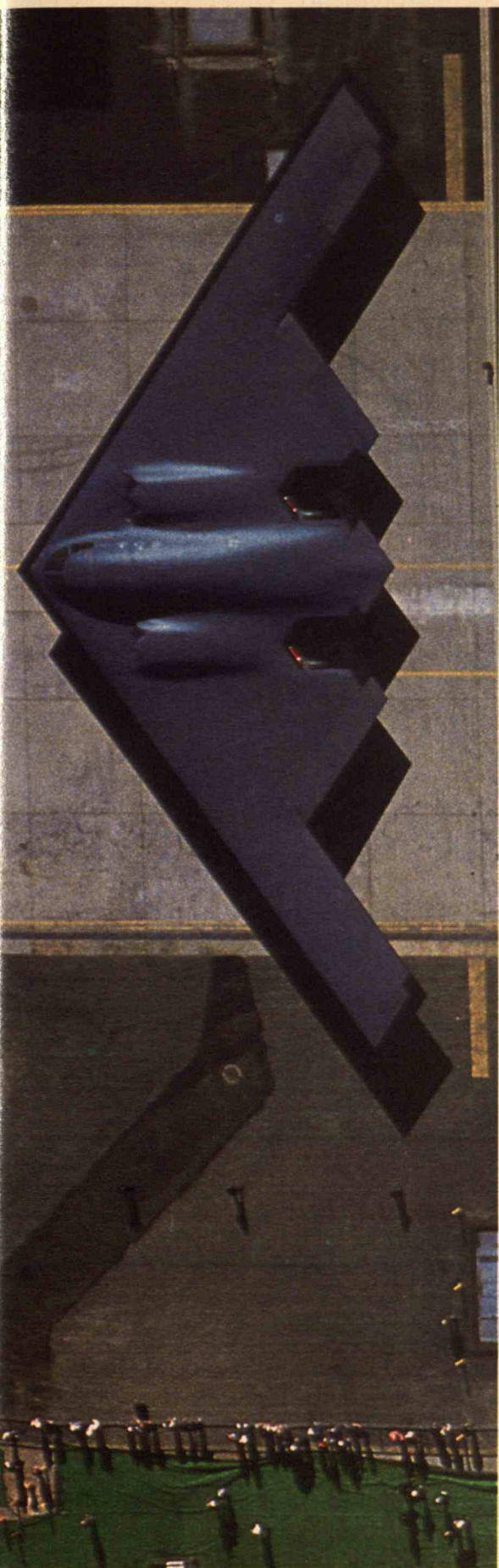
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Unveiling the B-2 bomber.





# The Technology of Stealth

BY JAY H. GOLDBERG

THE newly revealed stealth bomber and stealth fighter are rewriting the rules to the game of aerial hide-and-seek that began half a century ago. Just before World War II, radar replaced the human eye as the surest way of spotting enemy aircraft. Since then, warplanes have avoided detection by flying above or below the range of their adversaries' radar or by electronically jamming, muffling, or distorting it.

But aerial combat is rapidly changing. For one thing, sensors are getting more sophisticated. Both the United States and the Soviet Union now have ground radar systems that can pinpoint a plane with a single short pulse, before anyone can jam the signal. Today's jet fighters on both sides carry radar that can distinguish lower-flying aircraft from ground clutter. They also fire heat-seeking missiles, which lock on to the hot spots of an enemy plane instead of tracking it with radar.

At the same time, the range and accuracy of weapons is increasing. Air-to-air missiles can down a plane tens of miles away, and modern surface-to-air missiles can hit a moving target at a hundred miles.

These high-tech sensors and weapons make combat aircraft and other military vehicles more vulnerable than ever. In the bloodless language of military planning, modern warfare is approaching the equation "first detection equals first kill." For this reason, the new imperative in weapons design is stealth—an array of techniques for making a vehicle or weapon harder to detect.

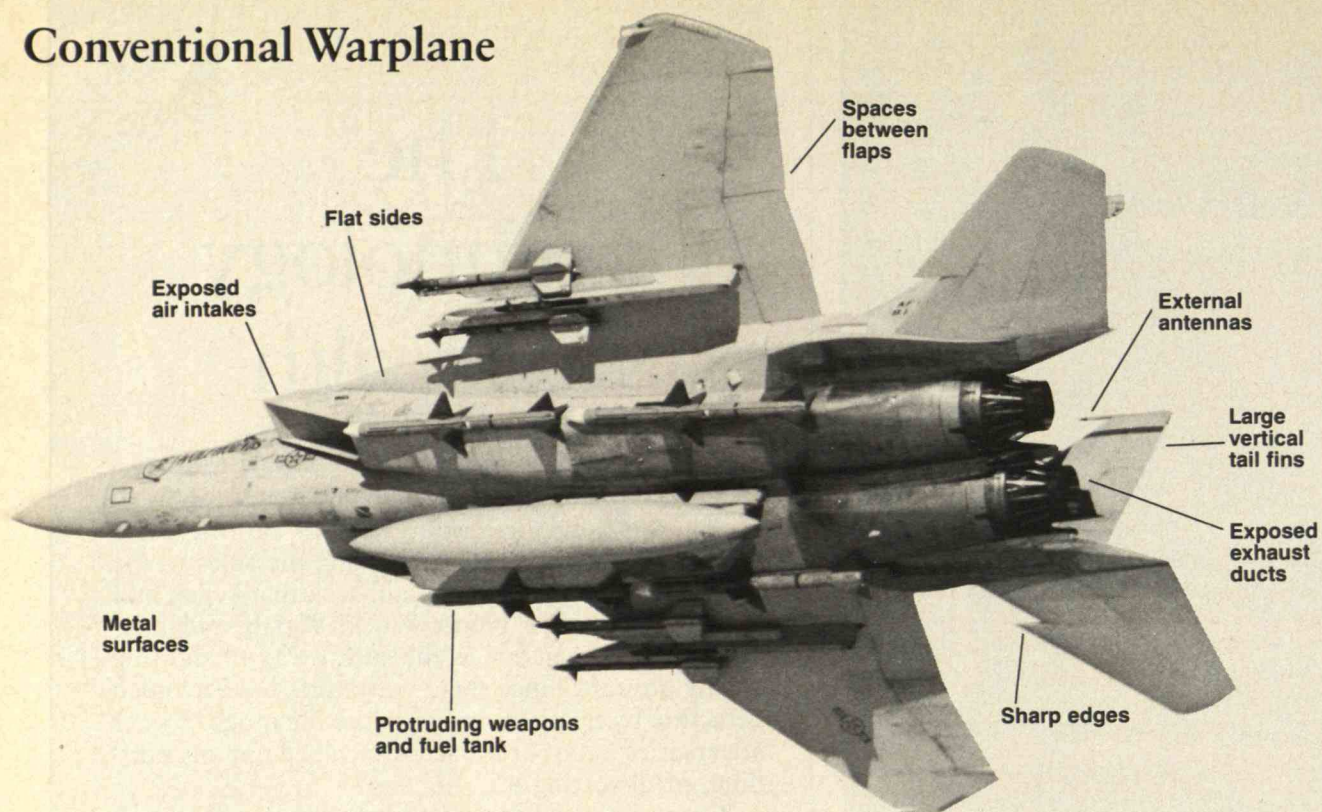
There's no such thing as a magic cloaking device.

*As the reach of weapons  
and sensors increases, combat vehicles are  
being redesigned to slip by undetected.*

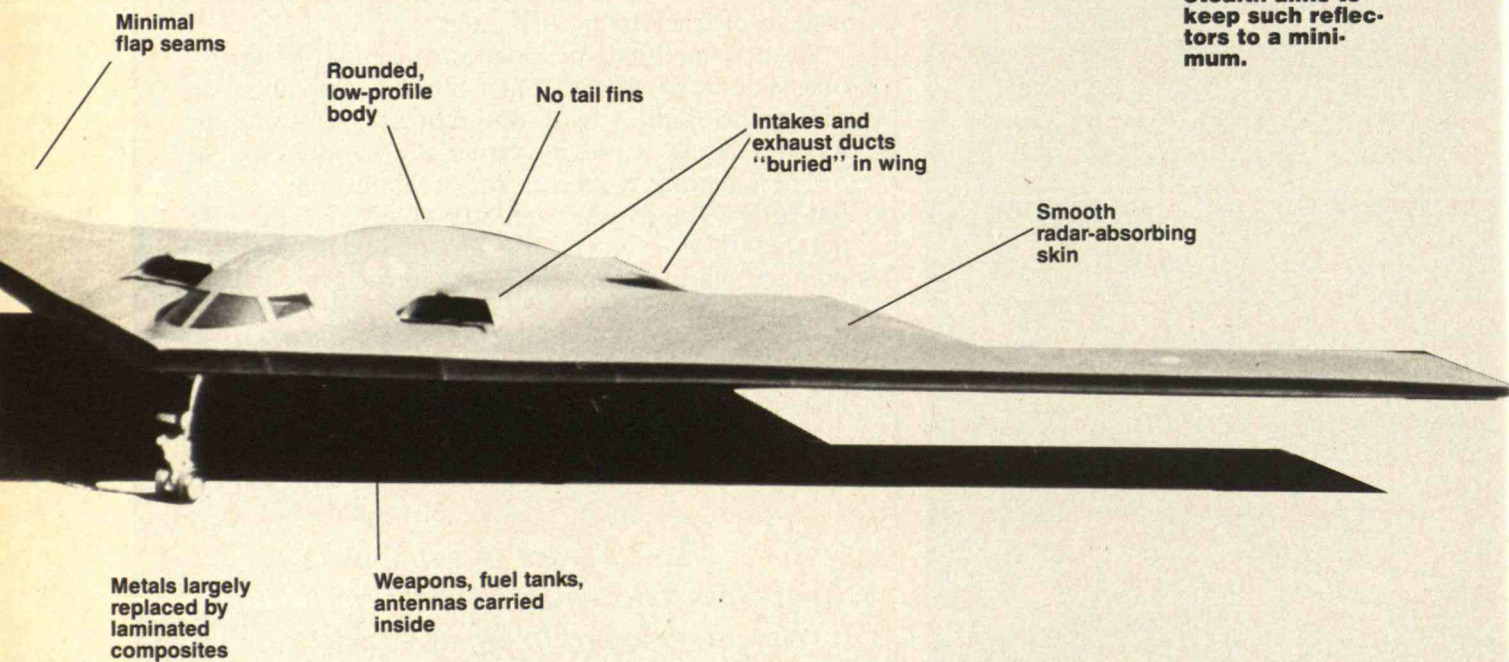
PHOTO: WILLIAM G. HARTENSTEIN/RENPHOT



## Conventional Warplane



## Stealth Bomber



When radar illuminates an F-15C (top), the fighter's many reflective surfaces are a dead giveaway. Stealth aims to keep such reflectors to a minimum.



*The U.S. Department of Defense  
plans to spend over \$100 billion on stealth programs  
into the 1990s.*

But features such as smoother contours, radar-absorbent coatings, cooler engines, and "quieter" electronics reduce the range at which a piece of hardware can be detected. The time gained may be critical. According to a Rockwell study, a fighter that reflected 98 percent less radar than normal could detect an approaching conventional fighter two minutes earlier than the adversary could detect the stealth plane. The Air Force Advanced Technology Fighter (ATF), a stealth plane slated for production in the mid-1990s, is expected to reflect 99 percent less radar than a normal fighter, about as much as a pigeon.

Convinced of stealth's growing importance, the U.S. Department of Defense plans to spend well over \$100 billion on related programs into the 1990s—more, even, than on the Strategic Defense Initiative. In addition to developing the ATF, the Air Force wants 132 copies of Northrop's B-2 stealth bomber (the hulking black boomerang unveiled in November 1988) and has bought 59 F-117A stealth fighters from Lockheed. The F-117A apparently became operational in 1983 but remained secret until last November. According to the Air Force, most of the aircraft ordered have been delivered to Nellis Air Force Base, in Nevada. The Navy is also working on a stealth plane—the Advanced Tactical Aircraft, similar to the Air Force's ATF.

Another imminent stealth weapon is the advanced cruise missile, being developed by General Dynamics. Today's cruise missiles fly low to avoid radar, but the latest Soviet antimissile defenses can detect them in time to jam their guidance radar or confuse them with flares or decoys. A stealth cruise missile would be nearly impossible to detect—and either divert or destroy—before it reached its target.

Stealth measures are also being applied to helicopters, drones (small pilotless aircraft), tanks, and even ships—in short, almost anything that moves.

### How It's Done

Stealth is often equated with making an object less visible to radar. Although this is an important consideration, designers must try to minimize other signatures, or sets of identifying traits, as well. Besides

its radar signature, a weapon or vehicle also gives off an infrared, an electro-optical, an acoustic, and an electromagnetic signature—each of which can be picked up by electronic sensors or human eyes and ears.

**Radar.** Of all sensors, radar has the longest range, detects and tracks most accurately, and is the least influenced by weather. Moreover, it is the most widely used and understood.

For stealth, an object's "radar cross-section"—its apparent size to an enemy radar—must be reduced drastically. If the cross-section is merely cut in half, the range at which the object can be detected shrinks by only 16 percent. To halve the detection range, the cross-section must be cut by 94 percent. (By the same token, a defender can double the detection range only by building a radar 16 times as powerful.)

The best way to limit a design's radar cross-section is to avoid efficient reflectors: flat surfaces, cavities, sharp angles, and irregular protrusions. On a plane, the airframe must be contoured and body parts smoothly blended. Weapons, fuel tanks, and antennas—normally conspicuous—are carried inside the plane or designed to conform to the body. Fins and rudders need to be small and tilted inward. Taken to its extreme, this approach results in a "flying wing" (the B-2 stealth bomber, which has no fins at all) or wedge (the probable shape of the advanced cruise missile).

Instead of metals, which are highly reflective, stealth airframes consist largely of composites, ceramics, and other materials that absorb or refract radar. They may also contain lightweight substances such as Schiff base salts—discovered by Carnegie-Mellon researchers in 1987—which absorb a wide range of radar frequencies and can be dissolved in



**The F-117A stealth fighter, in service since 1983, forgoes the usual stealthy curves for flat, angled panels that scatter radar beams. The plane's mission is to slip through defenses to strike heavily guarded targets.**

JAY H. GOLDBERG, of Gaithersburg, Md., is a defense consultant specializing in aerospace technology. His writing appears frequently in *National Defense*, the *Journal of Defense and Diplomacy*, and other publications.





airframe materials. Airframes are made even less visible by nonreflective skins and paints.

To limit gaps and cavities, designers avoid the large, exposed engine intakes and exhaust ducts of normal jet aircraft. These openings can be shielded, "buried" in the structure, or designed to widen and contract mechanically as needed. The B-2's engines are mounted on top of the wing, where they are less visible from the ground. Researchers are developing flexible skins to cover the gaps caused by moving surfaces such as wing flaps.

**Infrared.** Though not as powerful or reliable as radars, infrared (or heat) sensors are harder to thwart. Missiles that use them have downed more combat planes this decade than any other weapon. And because they are passive, emitting no signals of their own, infrared sensors are less detectable than radar. (Most aircraft sound a warning when illuminated by hostile radar.) U.S. combat aircraft have long carried infrared search-and-track systems, and nearly all Soviet aircraft now use them to back up radars.

For planes and missiles, the main way to evade infrared sensors is to cool the exhaust. This can be done by replacing turbojet engines with cooler turboprops, a likely feature of the advanced cruise missile. Another technique is to mix cold outside air with the exhaust. Research is also under way on fuel additives that would cool the exhaust without degrading performance.

To cool the rest of the aircraft, designers can make the body out of composites and paint it matte black or other colors that reduce solar reflection and aerodynamic heating. A more ambitious solution is

"closed-loop" cooling systems, which would cut heat from airplane cabins and missile airframes without venting it to the outside.

**Electro-optical.** Guidance and tracking systems based on lasers or TV cameras are becoming increasingly common. They are used mainly on air-to-surface missiles, but Switzerland's Oerlikon and Sweden's Bofors have developed laser guidance for surface-to-air missiles as well. Hiding an aircraft from such sensors is largely the same as hiding it from the eye. The best way to do so, aside from flying at night, is to minimize the plane's contrails—the long white streams of condensed moisture from the exhaust. This is being done via fuel additives and new engines. The ATF may use a ramjet, the exhaust from which is cooler and thus doesn't condense as readily.

Designers are also trying to make aircraft blend in better with their surroundings. One concept is "active camouflage," where a plane's surface would be illuminated in ways that constantly shift to match the background.

Many steps to reduce radar and infrared signatures would do the same for visible light. For example, composite materials and radar-absorbent skins are much less reflective than metal.

**Acoustic.** Jets make a lot of noise, particularly at supersonic speeds. Design features for reducing other signatures should help here as well. Turboprops and shielded inlets will result in quieter exhaust. And smoother airframe surfaces, lighter materials, and fewer moving parts will cut noise from the airframe and from inside the engines. Still, there is no known way to eliminate the sonic boom when an aircraft





**Stealth applications are growing. Left: Boeing Sikorsky's preliminary design for the U.S. Army LHX helicopter defies radar with its rounded surfaces, enclosed rear rotor, and composite body. Lightweight materials allow a smaller engine that gives off less noise and heat. Above: Thanks to their small**

**size and fiberglass construction, remote-controlled "drones" like Israel's Pioneer are hard to detect as they perform reconnaissance, guide weapons to targets, and patrol borders.**

breaks the sound barrier. Reportedly, both the F-117A and the B-2 are subsonic. In fact, even the high-performance ATF may fly below Mach 1 when it needs maximum stealth.

**Electromagnetic.** Emissions from on-board systems such as communications, radar, and avionics can betray the location of an aircraft or missile at great distances. Much of this problem should disappear as other stealth measures are introduced. Shielded from radar, a stealth aircraft will have less need for jamming. And because such a plane won't have to fly at treetop level, it can rely less heavily on terrain-following radar.

Other techniques can reduce the remaining emissions. Active sensors such as radars that track moving targets may give way to passive sensors such as infrared. Or an emitting sensor on a companion aircraft or drone could locate targets and send the data to the main vehicle. Navigation radars on missiles and aircraft could be replaced by "astro-inertial" systems, which navigate by the stars (the B-2 may already use this technique). And much of the wiring in various systems, which can "leak" electronic noise, could be replaced by fiber-optic cable.

Stealth designers are also trying to make communications harder to intercept. Some of the easier measures include switching to highly directional "narrow-beam" transmitters, keeping radiated power to a minimum, varying frequencies and signal formats, and keeping messages short.

A more revolutionary method is laser communications. Thanks to their finely focused beams, lasers are a virtually undetectable means of high-speed data transmission. The Air Force hopes soon to use lasers

that transmit up to 10—and eventually 100—megabits of data per minute. (McDonnell Douglas is under contract to build a prototype.) If a way can be found to penetrate clouds, lasers would be especially useful for communicating between combat aircraft and reconnaissance or battle-management planes (such as the AWACS, a jumbo jet outfitted with a huge radar dome).

## Land, Air, and Sea

So far, most of the stealth technology developed has gone into planes and missiles. But the U.S. military has started working on stealth for several of its more high-profile vehicles.

Helicopters, for example, typically need to fight at close range, yet their metal rotor blades, exposed engine, jutting weapons, and loud roar give them away for miles around. The Army's Light Helicopter (LHX), now being developed, will be a lot stealthier. Its rotors will probably be made of a composite, or of metal coated with radar-absorbing paint. Its contoured body will contain as little metal as possible, and its weapons will protrude little or not at all. The lighter body should allow the engine to be smaller and quieter.

Tanks are also easy to detect at long range. The Army is now exploring measures such as radar-absorbent coatings, smoother contours, and coverings for guns. It may also develop lighter, more agile tanks that use less armor.

Even surface ships, though impossible to hide when within visual range, can benefit from reduced radar, infrared, and electromagnetic signatures.



## *What happens when the Soviets finally thwart U.S. stealth systems? Second-generation stealth.*

American and British navy researchers are using supercomputers to identify vessels' telltale features. The most prominent structure is often the cluster of antennas on top of the mast. These may be reshaped or concealed. As with other types of weapons, naval stealth emphasizes radar-absorbing materials and paints, passive sensors, and more secure communications.

One of the most promising uses of stealth technology is in drones, as the Israelis showed in the 1982 war in Lebanon. Using these remote-controlled aircraft for reconnaissance, locating targets, and electronic jamming, the Israelis eliminated large numbers of sophisticated Syrian surface-to-air missiles without losing a single plane.

Drones are tiny (Israel's Pioneer is only about 13 feet long) and can be made of materials that resist detection, such as wood or fiberglass. Equipped with weapons, they would lessen the need to risk pilots and more expensive hardware in combat.

So far, the United States has made little use of drones. But as stealth gains priority in the battlefield, their value—especially for short-range missions—should become more evident.

### **Staying Ahead**

With all the money and effort it is pouring into stealth, the United States appears to be well ahead of the competition. The Soviets are catching up in some technologies, such as composite materials, passive sensors, and electronic jamming. But they lag in critical areas like computer-aided engineering, modeling and testing, and the integration of on-board electronic systems. Certainly, the newest Soviet aircraft and missiles show little evidence of stealth. The latest version of the Backfire bomber is more contoured but has huge, exposed engine inlets and a large vertical tail fin. The most recent, highly touted fighters—the SU-27 Flanker, the MiG-29 Fulcrum, and the MiG-31 Foxhound—are made almost entirely of metal, and display all the conspicuous signatures of 1970s Western fighters.

In the long run, the Soviets will probably acquire stealth. But the United States is already looking into countermeasures. Stealth-busting sensors will probably cover larger bands of the electromagnetic spectrum, with better range and accuracy. One approach will be multiple sensors operating in tandem, possibly over different frequency ranges, from different

locations. For effective long-range tracking, an early-warning radar will “pass” targets to closer-range, shorter-wavelength radars that can get a more accurate picture of an intruder.

Entirely new sensors are also being considered. For example, there is growing interest in detecting heat through ultraviolet emissions instead of infrared. Researchers believe a UV sensor would be less easily tricked by false thermal images such as flares.

And what happens when the Soviets finally come up with ways to thwart U.S. stealth systems? Second-generation stealth. Instead of relying mostly on passive measures—such as shaping, masking, using less detectable materials, and reducing emissions—the next generation is likely to be more active. Future aircraft and missiles may be able to create false radar or infrared signatures to confuse sensors. They may also incorporate structures like the “mission adaptive wing” that Boeing is developing. The wing will change shape automatically—say, enlarging for takeoff or condensing for stealthy high-speed cruising.

### **The Limits of Stealth**

Is stealth the last word in weapons design? Probably not. For all the advantages of low detectability, it would be impractical to convert all U.S. armaments to stealth.

One reason is that some of the design features hinder performance in ways that would not always be acceptable. For example, because an aircraft designed mainly for stealth must carry most of its weapons, fuel tanks, and antennas inside, the range and the space available for electronic gear are reduced. The firing of weapons also becomes more complicated. And with fins and other control surfaces kept to a minimum, stealth aircraft may fare poorly in close combat, where sharp maneuverability is a must. Just to remain stable, the Advanced Technology Fighter and the advanced cruise missile will need to incorporate highly sophisticated guidance mechanisms. Indeed, to make the ATF as agile as it is supposed to be, the Air Force will have to compromise on stealth. The plane will probably be more dependent than the F-117A fighter on jamming and other electronic techniques.

Often, stealth simply isn't needed. The current emphasis on stealth assumes a high-tech battlefield and a sophisticated, heavily armed enemy. More com-



# The Road to Stealth

**M**ANY of the stealth features used in today's weapons first appeared on spy planes. Soon after World War II, the U.S. government realized that the Soviet Union was too large and too secretive for intelligence gathering only by spies or military attachés. Conventional reconnaissance overflights were against international law. Undeterred, the Air Force set out to develop a plane that could see without being seen. The U-2, first flown in 1954, avoided detection by radar partly by flying at 70,000 feet but also by incorporating traits now associated with stealth: it had a squat, flat profile without protrusions, and was coated with nonconductive paint.

In the 1960s, after the U-2 piloted by Francis Gary Powers was downed by the Soviets and manned overflights were banned, the Air Force switched to an unmanned reconnaissance plane, the SR-71 Blackbird. The SR-71 is a true stealth aircraft, with smooth, rounded surfaces and radar-absorbent materials. Even today, an approaching SR-71 reportedly becomes visible to the naked eye before it shows up on radar.

Despite the stealthy turn taken by reconnaissance aircraft, combat planes continued to rely on conventional evasion techniques throughout the 1960s and 1970s. By the end of the Vietnam War, over half the planes on a typical U.S. bombing run were devoted to detecting and deceiving enemy radar. This was clearly an inefficient use of aircraft. And as the Israelis found out in the 1973 Yom Kippur War, such tactics were not reliable. Their air force suffered heavy losses



**Early stealth: SR-71 Blackbird**

when it confronted new surface-to-air missiles that resisted jamming.

The reason combat planes avoided stealth was that it compromised performance. If such 1970s warhorses as the F-14, F-15, and F-16 had been built with stealth in mind, they would have had to forgo their large engines, externally carried weapons, and active electronics.

Since the mid-1970s, however, several technological advances have made stealth warplanes more feasible. Thanks to supercomputers and computer-aided design, engineers can now predict stealth and performance characteristics, compare designs, and make changes on a computer before building models. This not only saves

money but also makes it easier to incorporate stealth features while sacrificing as little power and maneuverability as possible.

Increasing computerization aboard planes has also helped. As an aircraft's electronic systems become more automated and better integrated, they can get by on less information from the outside world. The pilot less often needs to use telltale data-gathering systems such as radar and communications.

Another big push for stealth came from the development of new composite materials, which are both less radar-reflective and less costly than metals. Because they are also lighter, they permit the use of smaller engines.

Armed with new tools and

materials, Lockheed first proposed a stealth fighter in 1974. According to sources like *Aviation Week* and *Jane's Defence Weekly*, the F-117A flew in prototype by 1977 and entered production by 1981.

The stealth bomber was conceived in 1979, two years after President Carter announced that he was canceling the B-1. The Strategic Air Command, foreseeing Soviet advances in air defenses that no U.S. bomber could counter, devised plans for what would become the B-2. At the time, Ronald Reagan was portraying Carter in the election campaign as soft on defense. Perhaps as a result, Carter accepted the stealth bomber proposal and announced it to the public.

—Jay H. Goldberg



*The prospects of a "stealth race"  
with the Soviets do not bode well  
for the economy.*

mon are "low-intensity" missions, such as combat against guerilla forces, a show of support for a small allied country, or punitive raids like those the United States has launched against Libya. Here conventional, reliable equipment is generally adequate.

Then there is cost. With all its advanced technology, a stealth design is bound to be expensive. In 1950, only 1.5 percent of a fighter's price stemmed from electronics (an F-100 cost about \$5 million in current dollars). Yet well over half the ATF's price tag of at least \$35-40 million will be for stealth measures, computers, and electronic systems.

Costs are aggravated by the uncertainty surrounding stealth design. Much of the technology is new and requires extensive testing. And military planners keep upgrading the specifications for stealth systems, adding features they hadn't anticipated. The B-2, for example, had to be redesigned in 1983, when the Air Force decided the bomber should be able to fly at low altitudes.

Not surprisingly, cost overruns and schedule delays have been rampant. The estimated cost of building 132 stealth bombers has risen from \$36.6 billion in 1981 dollars to well over \$60 billion in today's dollars. And the advanced cruise missile, planned as a \$5 billion program, is said to be three years behind schedule and heading for \$7 billion. In all likelihood, some stealth features or the number of weapons will be cut back.

According to the Department of Defense, current stealth programs are still a good deal, overruns and all. They claim that stealth will cost more to defeat than to build. Whether or not that turns out to be true—and many critics doubt it will—the prospects of a spiraling "stealth race" with the Soviets do not bode well for the American economy in a time of shrinking budgets. Clearly, stealth gives U.S. weaponry a technological edge. But for that edge to be worth the investment, the costs of attaining it will have to be managed very carefully indeed. ■

# DAEDALUS

HOW TECHNOLOGY RECREATES A LEGEND

On April 23, 1988, after three years of planning, testing and perfecting technology, a 70-pound aircraft called *Daedalus* was pedaled 72 miles from Crete to the island of Santorini—breaking the record for human-powered flight.

John Langford, the project manager for the journey across the Aegean, tells how his team combined technology with perseverance to achieve this new world record.

Because of the popularity of Langford's article, it is available in reprint form. Considered by many to be the most in-depth article on the subject, it allows you to relive this historic event. The reprint is filled with stunning full color photographs that capture the making of the flight.

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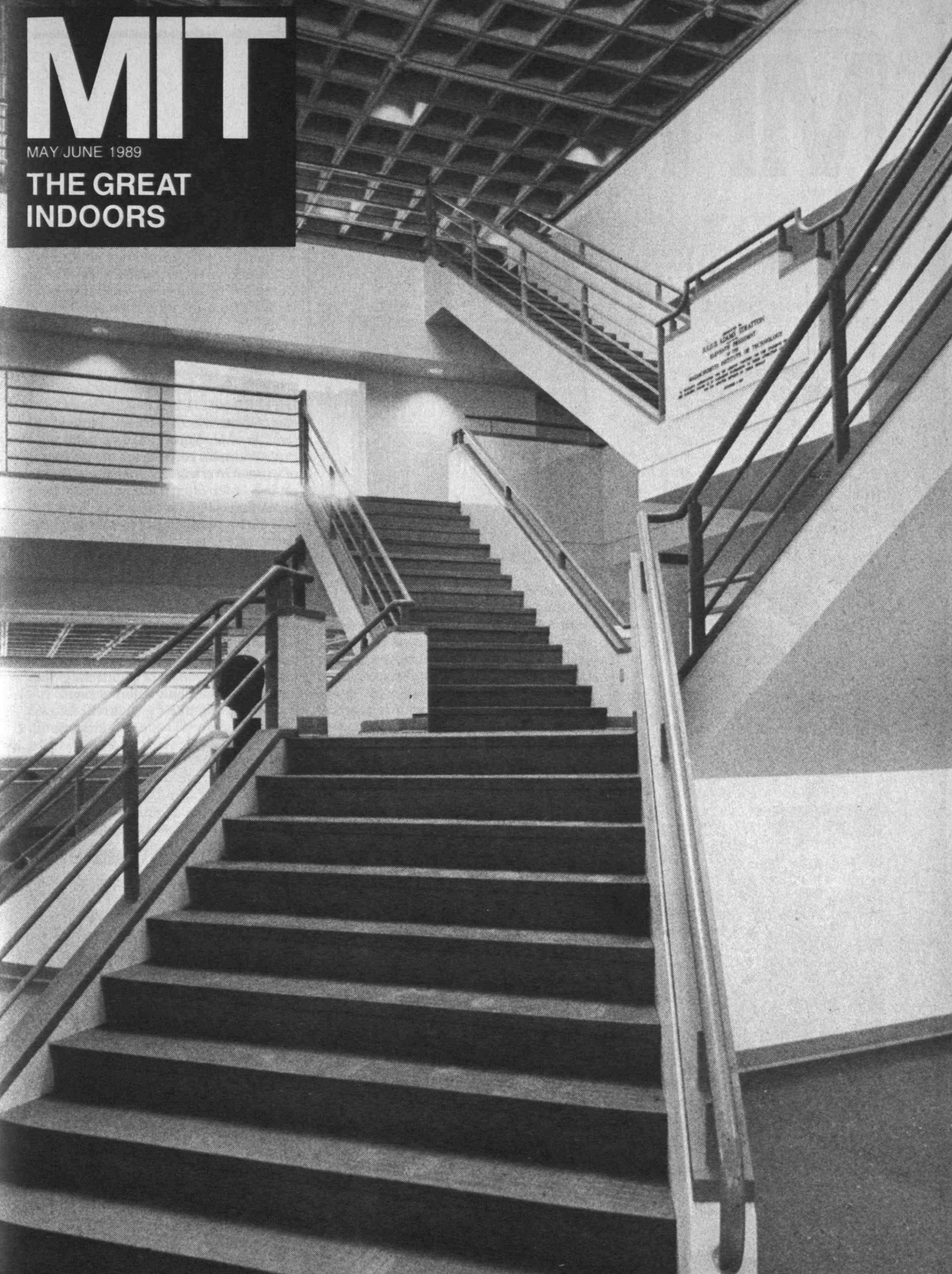
The Making  
of the  
Legend



# MIT

MAY JUNE 1989

## THE GREAT INDOORS





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## COVER

The dramatic architectural details of the Student Center renovations lend themselves well to interesting photography—but more to the point, they lend themselves to smooth traffic flow and an air of sociability. (Photo: Sam Ogden)



## ADMISSIONS DEBATE STILL GOING STRONG

Ralph Schmitt's entertaining letter in the February/March edition of *Technology Review* (page MIT 2) about undergraduate admissions and curriculum brings to mind some questions: Do high SAT scores predict a high grade point average at graduation? Do they predict success 10 years later? How will we measure success 10 years hence? Why would today's students be deficient in physics but not in chemistry?

I wonder if the standards my good friend Ralph nostalgically recalls are really eternal truths, or are they relics of a simpler age. Is he making the complex simple (which is worse than making the simple complex)?

CHARLIE SPIEGEL, '32  
Redondo Beach, Cal.

The unsupported qualitative assertions of Provost John Deutch, '61 (*August/September 1988*, page MIT 19) that the Institute "requires a more diverse entering student population, it requires a broader curriculum..." raises some questions. What hard data are available to suggest that more broadly educated students solve large social problems better?

In responding to the criticism of Ralph Schmitt (*February/March*, page MIT 2), Deutch says "My point is that MIT's science and engineering students must attain an understanding of how society can successfully adapt the benefits of new

technology." Certainly political resolve is a necessary ingredient in the successful adoption of new technology and the solution of large social problems. How is the discipline of achieving political resolve derived from the educational charter of MIT?

ROBERT M. COPSEY, '44  
Hidden Hills, Cal

## DIFFERS WITH WIDNALL

Part of the article about Sheila Widnall, '60 (*February/March*, page MIT 4), dealt with Prof. Widnall's concern for the problems of women in engineering. It quotes her as saying, "Men often feel comfortable with a communication style that seeks to reduce one of the protagonists to rubble in the course of a scientific discussion." I was chagrined to come across such a blatantly sexist statement in *Technology Review*. I have been in engineering long enough to have participated in many technical discussions, and I found the pathological behavior described in the quotation to be rare, even among men. Surely the advancement of women in engineering does not require the denigration of men.

ROBERT J. TURNBULL, '63  
Urbana, Ill.

## TECHNOLOGY REVIEW

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## Ethical Tools More Useful than Rules

*Editor's Note: Last fall's campus-wide colloquium entitled "How to Be Good" drew a standing-room-only crowd of students, faculty, and staff to the Sala de Puerto Rico to consider the ethical and moral issues embedded in the work of scientists and engineers. The panelists were Professors Noam Chomsky, Philip Morrison, and Sheila Widnall, '60. Disagreement with Professor Widnall's presentation led to a two-part column in The Tech by Jonathan Richmond. Richmond is a graduate student in the Department of Civil Engineering and teaches 1.962, a subject that includes the application of moral philosophy to questions of transportation policy. What follows is a condensed version of Richmond's column.*

I doubt that there is much overt dishonesty at MIT. But there is much narrowness—a tendency to ignore the context in which engineering work is set, to avoid asking whether the research carried out can be defended ethically, and to avoid asking if the techniques used imply an ethically justifiable system of evaluation.

Ethical discussions tend to focus on—and quite rightly condemn—the deliberate, conscious manipulation of techniques for financial gain. The stated ethics of engineering practice usually deal with black-and-white issues where it is clear whether behavior is ethical: the selling of an unsafe product, the dumping of hazardous waste, or the falsification of financial reports, for example. Such cases of obviously corrupt behavior do draw attention, if not enough. Despite the unpalatable behavior of a minority, most engineers are, after all, honest. Most would object to releasing a product that they knew to be defective or dangerous. Few professionals would condone explicit lying in presenting financial data. Many, however, leave unexamined the most basic tenets of their professional lives.

That is why a far more prevalent problem, the "honest" misapplication of techniques, is seldom addressed. It attracts little attention because those responsible are not even aware of it.

The most provocative comment of the colloquium "How to Be Good" came from graduate student Daniel Glenn, who touched on just this issue. People who manufacture bombs, he said, are making "a very unsafe product, and [their] job is to make it as unsafe as possible." While many professionals will be concerned to



make sure that the product is built to specification and within the budget, few will question whether it should be built at all.

That crucial question is too often left unexamined not only in the defense industry, but in all areas of engineering endeavor. And no wonder. It is much easier to accept your task as given than to challenge the larger assumptions behind that task, which may include the acceptance of killing people (as in the defense industry), the disruption of community (as is occasioned by many highways, office complexes, and other civil engineering projects), or the alteration of the very way we receive and understand information (as is implied by many computer science developments) or (as with research in artificial intelligence) the way we understand ourselves. In all cases the engineers may see themselves as behaving perfectly ethically according to their own narrow terms of reference.

Existing courses in engineering ethics of the type Widnall advocates fail to provide a systematic and rigorous examination of ethical issues fundamental to all engineering practice. Reading case studies in which engineers behave in corrupt ways and discussing how they might have acted better can make students feel good. But doing so does not necessarily provide a way of asking the essential "meta" question of "Am I asking the right question?" when dealing with particular

engineering approaches or techniques. Nor does reading such studies instill a theory capable of unmasking the ethical presuppositions of engineering inquiry in general.

It is part of engineering mythology that work can be done "objectively," and that if professionals apply their techniques correctly and without bias, then they have properly discharged their duty. But there is no one correct way of choosing assumptions, and it is generally the choice of assumptions as much as the application of engineering techniques that determines what impact a project will have on the lives of thousands or millions of people.

There is a rather naive belief around MIT that taking more courses in humanities will in itself somehow make one more humanitarian. That is a myth. Relying on humanities to make students better people also conveniently avoids the issue closer to home. While engineering departments can teach techniques, the humanities can provide for the humanistic side of things, it can be argued. But it is only when engineering is made to clash directly with its ethical assumptions that real progress can be made.

What it boils down to is that ethics as seen by Widnall is treated as something that is "fascinating" rather than fundamental. Ethics is treated as one of the pursuits of a well-rounded person, like art or music appreciation. It sits off to the side, rather than taking center stage in the engineering curriculum. That is wrong, for there is nothing in engineering that does not have ethical implications, neither the choice of a subject to be studied nor a means for studying it.

Despite all the above gloom and doom, there are some encouraging signs at MIT. Students in the Technology & Policy Program and the Program in Science, Technology, & Society are being made aware of many of the larger issues affecting our understanding of technology. The Integrated Studies Program for freshmen also sets a healthy precedent. New this year, furthermore, are "context" subjects taught by engineers and humanists, scientists and social scientists, who explore the context in which science and engineering are set. These courses are, however, taken by a small minority of MIT students, and only by those predisposed to be sympathetic to such issues.

*Continued on page MIT 19*





The Catherine N. Stratton Lounge is now one of the most inviting spots on campus.



# The New Student Center

## DOWNTOWN MIT

BY LESLIE BRUNETTA

In March, construction crews were finishing up in the Julius Adams Stratton Building—the Student Center, in common parlance. LaVerde's Market, the building's newest tenant, was moving in. A three-year, \$12 million renovation project—intended to transform what most people at MIT considered a cold, dark, unfriendly place into a light-filled, welcoming community center—was almost complete.

While it's not likely that the new center provides all things to all people on campus, it's hard to think what more could have been added to the building. A huge array of food is now available, from tea and "atomic fireballs" in the Student Center Committee Coffeehouse to champagne and oysters in Networks, the new upscale seafood restaurant run by MIT Food Services.

There are two art galleries, one showing work by students and the other work by well-known graphic artists. The new retail complex that takes the place of the old Coop department store provides standbys such as tailoring, cobbling, and optometry services, as well as new offerings ranging from ice cream to records to micro-computers. A "mini-Coop" will stock stationery and office supplies, MIT insignia items, and general-interest books.

*Former Fulbright scholar LESLIE BRUNETTA is a Somerville-based free-lance writer and the daughter of Frank Brunetta, '49.*



*Students in jeans and professionals in pin-striped suits can be found at all hours playing video games at the MIT Student Center.*

The campus consensus seems to be that the renovation is a success—business in the redesigned Lobdell Dining Room is up 20 percent, and the deeply padded chairs in the new Catherine N. Stratton Lounge are usually filled with students. "I don't think anyone in his right mind could have imagined how lovely the Stratton Lounge and how cheerful the rest of the spaces have turned out to be," says Warren Seamans, director of the MIT Museum, whose museum shop is another new Student Center tenant. "The renovation has made the building a campus center again."

The Stratton Building did have some inviting areas in the original 1965 design by Eduardo Catalano, professor emeritus of ar-

chitecture. But owing to a desperate shortage of general-purpose space on campus, the building could never be used fully as Catalano conceived it. A fragmented management scheme that had parts of the building operated by Food Services, the Dean of Students Office, the MIT Libraries, Physical Plant, and the Undergraduate Association only compounded the problems.

The stage was set for change in January 1985, when Stephen Immerman was appointed to head a collective effort to resolve the Student Center's administrative morass. (Immerman had won the respect of many on campus as assistant dean of students, responsible for fraternities and other student organizations and activities.) What emerged from that effort was the Campus Activities Complex, which brought together the program and operational management of the Student Center, Chapel, Kresge Auditorium, and various areas occasionally used for community events, such as Walker Memorial and the Athletic Center. Immerman was the complex's first director of operations.

He could see that the Student Center needed large-scale renewal. The heating and ventilation systems were decrepit. The basement kitchen, serving not only Lobdell but also all conferences and other catered events on the West Campus, daily turned out more than three times the number of meals it had been designed to produce. Lack of a kitchen freight ele-





■

*Book a  
flight; get a  
haircut; buy a  
pop comic, a  
compact disc,  
or a hard drive  
for your Mac—  
you can do it all  
at the  
new Student  
Center.*

vator often meant that passengers had to ride shoulder-to-shoulder with french fries and goulash in what many have described as the slowest elevators in the Western world. Moreover, the building had an antiquated fire detection and suppression system and was largely inaccessible to the disabled.

Within months of Immerman's taking office, the Coop announced plans to relocate to Kendall Square. "This meant that about 30,000 feet of retail space would open up and that we had to rethink how to serve the convenience needs of the community," says Immerman.

The timing of all these events proved to be fortuitous. In the last few decades, there has been a revolution in the concept of what a student center at an American university should be. Student populations are more culturally diverse, and the increased numbers of women have had profound effects on campus life at schools like MIT that once barred or limited their enrollment. A campus

can no longer be regarded as a quasi-monastic retreat from the outside world, where students simply accept the wisdom of professors and administrators.

Instead, universities have become cross sections of the larger society. Student centers—and their design processes—should reflect that fact, says Henry Moss, the staff architect for the renovations. "If what you're interested in is fostering interactions between people, then you view this center as a piece of urban design," Moss says. "It's not just that you have a Post Office outlet, some vending machines, and a snack bar, which after all would take care of most people's basic material needs. What you have here now is a hunk of city."

To define the shape of this particular hunk of city, Immerman formed two working groups. The "client team," made up mostly of students, would focus on the redesign of the building's interior—what retailers were most desirable, how Lobdell could be improved, and, most important, what the building's image

should be. The "project team," made up of administrative staff members who had a stake in the building's operation, would focus on the nuts and bolts of how the center would actually work—what was needed in the kitchen, where conferences could be held most comfortably and efficiently, how new rental income could be made to cover debt service on the renovations.

In the meantime, MIT hired a development firm to conduct an architectural and financial feasibility study, and a marketing firm to produce a detailed analysis of retail options. And about 800 students responded to a survey asking what they did and didn't like about the building and what changes they would like to see.

The search for an architectural firm able to transform the center without disturbing Catalano's monumental exterior ended around the corner on Vassar Street. Cambridge's own Bruner/Cott & Associates was chosen by Immerman's teams on the basis of its past work with existing buildings, with educational institutions, and with low-budget housing projects demanding sensitive reconciliation of various groups' conflicting desires.

Bruner/Cott's extensive experience in urban design also worked in its favor, says Immerman: "We felt that this building was very much like the downtown of MIT. Kresge is our civic center; we have our town chapel; and the oval is our town green. This complex is the only place on campus that has a 'central' sense to it, so we wanted architects who would respond to these social concerns rather than just design a shrine to themselves."

The most common complaints about the building's original interior were that it was dark and unwelcoming and that access between floors was difficult. "It was like a dungeon," says Jan Marie Hernandez, '89, current manager of the SCC Coffeehouse and member of the advisory board to the Campus Activities Complex. Hernandez took part in much of the renovation's design process. "You couldn't tell what was happening on other floors, and it wasn't a place you wanted to hang out in anyway. It was depressing."

Even if students had been inclined



to hang out in the Stratton Building, the only available spaces were Lobdell, whose vast expanses were perceived by many to be both physically and emotionally chilling, and the Coffeehouse, which had limited seating. Catalano had designed the second-floor Sala de Puerto Rico as a luxurious lounge, originally decorating it with oriental carpets, chesterfield sofas, and cozy lighting. But soon after the building's opening, the room was taken over as a much-needed conference, party, and stage area; by the mid-1980s, the campus had been without a central lounge for about 20 years.

Having read the surveys and met frequently with the client and project teams, Bruner/Cott tackled each of these problems in a dramatic fashion. "We tore about 300 tons of concrete out of the center of the building to create a new, open staircase," says architect Henry Moss. "Now you can instantly see what kinds of environments are available to you as soon as you enter the building." Newcomers can quickly decipher the center's layout by looking up through its core. And regulars have found that the staircase lends a new air of sociability to the center. (The staircase includes ramps that make the entire center accessible to the disabled.)

"I've often stood outside the Coffeehouse," Hernandez says, "and seen people on the first and second floors and called out to them. It's a really interactive design."

**T**o bring more light into this central area, Bruner/Cott decided to open up the Kresge Oval side of the building with a glass wall stretching from the floor of the second floor to the ceiling of the third. From the outside, this wall blends into the building's lines as originally drawn by Catalano. But from the inside, the massive window—brought down to human scale by its framework's grid pattern—is perhaps the most striking of the center's new features. Facing south, the window floods the center with warm sunlight through much of the day and grants panoramic views of the chapel and Kresge Auditorium designed by Eero Saarinen as well as a glimpse of the Charles.

"As we spent time getting to know the building before the renovation, we saw that students seemed to be hap-

**Three  
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of concrete  
were torn out of  
the old  
Student Center  
to make room  
for the  
dramatic stair-  
cases that  
invite vertical  
sociability.**



piest sitting around in the sun on the plaza at the top of the grand entrance steps," says Moss. "We thought it would be a good idea to try to take that part of the building and bring it inside. It was also an attempt to take Catalano's idea of a well-appointed living room and to bring it over here where there was a good view."

The new "campus living room," basking just behind the window, has been named in honor of Catherine N. Stratton, wife of MIT's 11th president. Kay Stratton has been active for decades in promoting the arts and enriching the quality of student life at MIT. The lounge is on two levels: The lower level, on the second floor, has the ambience of a sophisticated, but not stuffy, hotel lobby. The walls are painted a restful deep green and the ceiling a clean white. The large chairs and sofas are covered in either black or burgundy, are accented with chrome, and arranged in small groups around marble-topped tables. The floor is covered with textured carpeting; plants and four ficus trees in huge terra cotta pots tie the room's interior

to the green of Kresge oval outside.

Although voices and music from the central stairway filter in, the lounge remains a tranquil resting place where the most common activities seem to be talking, newspaper reading, coffee drinking, and window gazing. On a balcony overhead is the lounge's upper level, where the same furnishings have been used, but the space is completely open to the building's central core.

Moss admits that there are some problems with the lounge. "Some of the furniture has already been stolen. But it was our view that we shouldn't simply respond to the inherited belief that a few students are going to treat everything so badly that you should give neutral, ugly, indestructible appointments to all the other students. We're demanding more responsibility from the students, but most treat it very well and seem to appreciate the space."

Another gamble taken in response to students' desires is the Networks restaurant. Client team students and others surveyed said they wanted an





## *The eternal cafeteria line has been replaced by efficient swirls of traffic.*

upmarket dining spot on campus where they could go with a date or their parents. Immerman and Food Services management soon realized that on any given day, about 25,000 people are at MIT, many wishing that they could once in a while have an elegant but informal meal without having to thrash through Boston's infamous traffic or waste precious time hiking to Kendall Square or beyond.

Networks is a risky venture because MIT, as a nonprofit institution, won't spend money on advertising; the restaurant can't be seen from Massachusetts Avenue; and there's no parking available. That means the restaurant is unlikely to attract much trade from off-campus. It will take about a year to see whether the restaurant (which, unlike the rest of Food Services' operation, pays rent to MIT) will be a success.

**T**he notions of a central staircase, great window, Stratton Lounge, and restaurant made their way through the team design process fairly smoothly. Other aspects of the renovation took more wrangling. The

old SCC Coffeehouse, for instance, had to be relocated to make room for expansion of the Lobdell serving area next door. The original plan called for it to move to the basement; but its staff—with heavy support from the client team—pushed hard for a change. Says Jan Hernandez: "We thought people wouldn't find us in the basement. And we're open 24 hours; we just felt safer being in the main part of the building."

After a long series of discussions, the final decision was to place the Coffeehouse on the third floor. This isn't an ideal location, according to Hernandez. Non-student sales are off from pre-renovation levels, perhaps, she believes, because many people enter Lobdell on the second floor without realizing that some of the same products are available at lower prices upstairs. The sales drop hurts, especially as the Coffeehouse is now paying off the \$80,000 borrowed to finance its part of the renovation.

But Hernandez thinks the design process was a good one: "Steve and the architects never said, 'Well, you're just going to have to do this.' Everyone pushed their own points, but it

was a very balanced give-and-take. The students were definitely taken seriously."

Give-and-take was also crucial to the redesign of Lobdell. Students on the client team and those answering the survey said that they wanted food to be available 24 hours a day, a menu with more variety, and a more comfortable place to eat. And they didn't like waiting in line. So the old serving setup has been broken up into brightly lit, tiled islands, one serving fresh pizza, one grilling hamburgers, one offering deli sandwiches—no lines at most hours, short lines at the busiest times. These islands are open from 7 AM to 11 PM.

During the usual lunch and dinner hours, there's also a salad bar and a bakery, as well as a more traditional entree station. But even the tradition has been updated: while the standard four-week rotating menu remains, a two-week specialty menu has been added. Says Eugene Perkins, the center's Food Service director, "For two weeks it's Chinese, then Greek, then New England seafood, then something else. We're trying to keep the boredom out of our menus."

In the dining area, balconies with wide stairways have been added to each end of the two-story room, responding to students' wishes to have the space seem less cavernous. Carpeting, upholstered chairs, small table groupings, and a soft blue, gray, and purple palette help the room to seem quiet and relaxed, even when filled with hundreds of diners. And the balconies can be screened off from the main room, affording extra space for conferences or private banquets.

The stairs leading up to the balconies are yet another example of how the team design approach affected the final renovation. "We brought in a model of Lobdell one day with Bruner/Cott's design for the balconies," says Immerman, "and one student literally tore the stairs off the model and moved them so that we could see what he was saying, which was that they would block the natural flow of traffic. That's what was great about the process, because we eventually saw that he was right."

Oh, and about those elevators: they are still there, but with totally new innards they run twice as fast. And the french fries and the goulash have a kitchen elevator of their own. □



# Ripples across the Academic Computer Market

**A**lmost six years ago, Digital Equipment Corp. and IBM could see that college students and teaching faculty were a large—and largely untapped—market for their products. But it was not at all clear how that market would develop, what would be its priorities or its most important innovations.

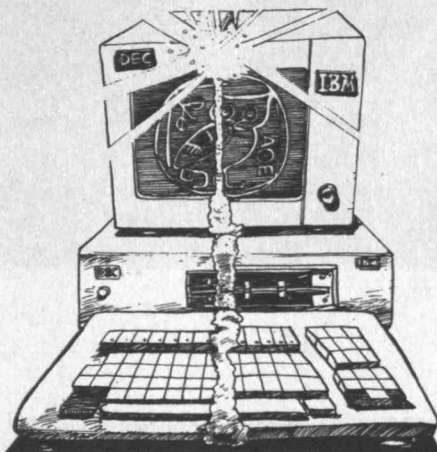
Today, after DEC and IBM invested more than \$50 million in MIT's Project Athena, there are state-of-the-art workstations all over the MIT campus, students and faculty are using the computers regularly, and much has been learned about large, multi-vendor networks in academic settings. But the academic market is almost as open-ended as it was in 1983.

IBM and DEC have had very different approaches to Athena, even though both chose to provide the primary funding for the project for similar reasons—to improve higher education and to establish a showplace for their first generation of high-performance workstations in that setting.

"Everybody was convinced that there was going to be a feverish level of activity," says Lesin Comeau, who oversaw IBM teams at both Project Athena and Brown University from December 1984 until February 1987. (Comeau has since left IBM to become the manager of the Academic Computing Facility for the Harvard—MIT Health Sciences and Technology Program.) IBM anticipated "lots of PC-style computers, tied together with networks," he says. "Besides benevolence, there was the idea that this was going to be one hell of a big market."

DEC had similar objectives: "It was abundantly clear that the advent of workstations was going to change dramatically the way computer services were

*SIMSON GARFINKEL is a freelance writer living in Cambridge, Mass. This completes his series on Project Athena.*



BY SIMSON L. GARFINKEL, '87

implemented," says George Champine, who directs the DEC Athena group based on campus. DEC "wanted to be part of an early implementation of a large-scale system," he says. But DEC also wanted to "make a contribution to improve the quality of higher education. . . . That sounds very altruistic, but it is true. We get our professional work force from the higher education system, so we like to improve it to any extent possible."

The two computer manufacturers promised MIT both hardware and on-site personnel for the duration of the experiment. In return, the companies got a national showcase for their equipment, the rights to use any system software developed by Athena, and—perhaps most important—much needed experience with the applications of workstations at a technically oriented university. But the experiences of DEC and IBM in integrating the knowledge they have gained back into

their corporate operations have been very different.

The DEC Athena group was managed by Digital's External Research Division, a group designed to "bring back interesting and useful things to the company," according to Steven R. Lerman, '71, Athena's former director.

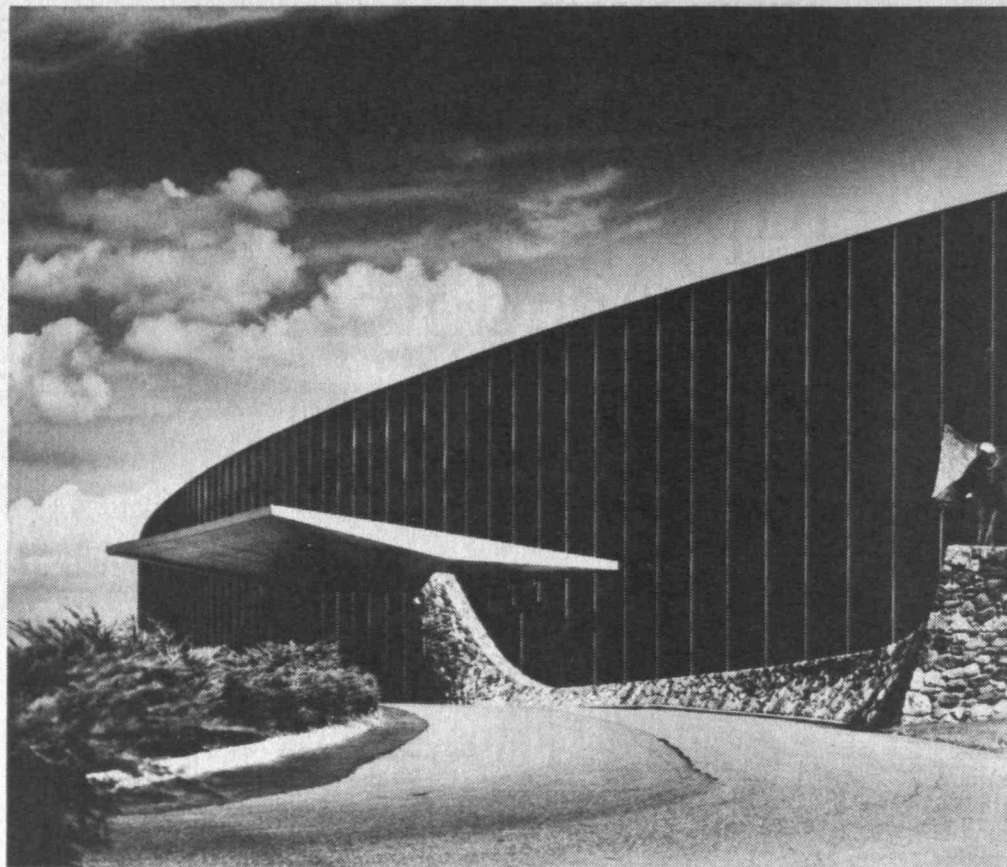
At the end of Athena's first five years, DEC assigned a full-time technical writer to the job of preparing an eight-volume internal report on Project Athena. The company ensured that the X-window system, Athena's most important single achievement to date, would be fully functional in the new VAX Station 2000 by having Jim Gettys, a DEC employee who was a key contributor to X, serve on the design team for the VAX 2000.

Further, Digital is applying Athena's "coherence" concept to its own commercial offerings and assigning 1,200 software engineers to the task of transporting the X-window system to both Ultrix, the company's version of Unix, and VMS, a proprietary operating system. "It was the largest software project ever undertaken by DEC," says Champine.

IBM's contribution to Athena, on the other hand, has shifted among several groups. Originally it was the province of the IBM Academic Information Systems (ACIS), but ACIS was broken into two different IBM divisions—one for sales and marketing, the other for technical systems support. "[These units] are less closely tied to the products," Lerman says, and they "don't have a corporation-wide charter" to push for the adoption of outside technology.

Another issue was hardware. Athena software was developed to run on DEC's standard line of workstations. But the equipment that IBM provided to Athena—the RT—is simply not the mainstay of the company's line of high-performance desktop computers, and software written for the RT will not run on





*It was difficult to lure engineers based at IBM's T.J. Watson Research Center in Yorktown Heights, N.Y., to the company's on-campus Project Athena team because it meant relocating to the Boston area for a year.*

other new IBM machines.

"The result is that DEC has gotten more out of Athena," Lerman concludes, "not because it has more rights, but because it was better structured to use it."

Even their locations—DEC's corporate headquarters are less than 25 miles from MIT; IBM is based in New York State—worked better for the former. As IBM's project manager at Athena from 1983 until 1985, Richard Parmelee, PhD '66, was responsible for staffing. "I had a very hard time getting people," he says, noting that "we don't have a Maynard nearby"—a reference to DEC's research center in Massachusetts.

"The list of people to draw from is very limited. Relocation is hard. . . . We hired new people, but in the new-hire market, there is an awful lot of competition for good Unix people. We tried to get support out of research, but mostly people who are in Yorktown [IBM's research center in New York] don't want to come here for a year."

Parmelee maintains that his search for qualified engineers was further compounded by MIT's insistence that the company would not own the fruits of the IBM group's Athena work. Inside IBM, he says, patents and developments contribute to an engineer's prestige and career advancement. But no such advancement was to be

had for those working at Athena. Because of this, working at Athena for an engineer "was nearly the same as going on an educational leave."

James D. Bruce, MIT's vice-president for information systems, sees "different corporate cultures" at the root of the variations in Athena's interactions with IBM and DEC.

"Ken Olson ['50] learned very early that ideas out of the university were very valuable in the marketplace," Bruce says. He notes that Digital showed its commitment to MIT early in its history, when it gave one of the first PDP-1 computers to the Institute.

"IBM is far more market driven," Bruce says, "and therefore a different culture. It had greater difficulty adapting that culture to Athena, and I think it shows. It shows in the way the staff interacted with the project, and the difficulty of getting an IBM workstation. [It also influenced] the rate at which technology developed at Athena flowed back to the corporation."

Nevertheless, says Carol Crothers, IBM's manager of technical computing development projects, which oversees projects at several universities, "We learned a great deal from the experience at MIT. One of the things we learned is that there is a growing need for Unix-based distributed

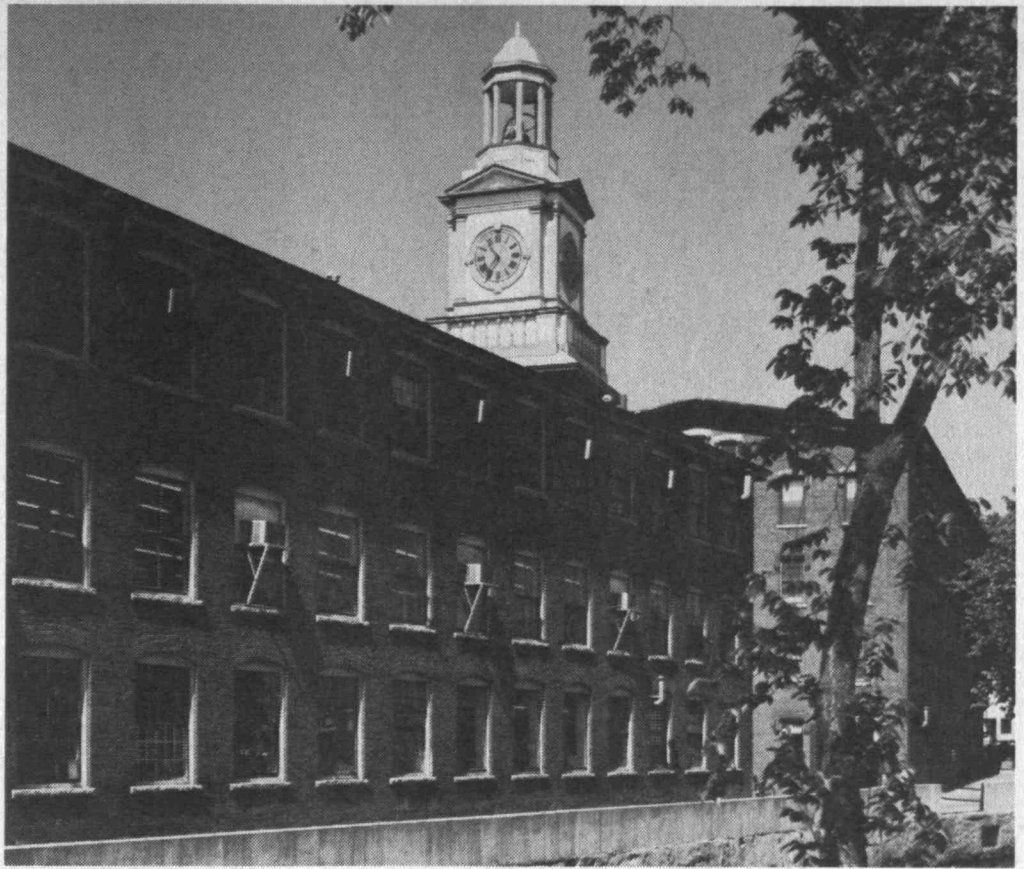
(networked) systems." IBM expects that its PS/2 personal computers, which run either MSDOS or the IBM Unix operating systems, will fill that niche very well, Crothers says. As for the RT, Crothers says that machine seems destined to be used as a high-performance network file server.

Nearly all of the \$20 million that MIT originally raised for Athena curriculum-development projects has been spent. And while DEC and IBM agreed to continue their support of the project for three years beyond the original 1988 deadline, they are not funding curriculum development.

"It took longer to develop the educational software than was expected," says DEC's Champine. "The [policymakers for Athena] made a big push to develop educational software before the system was ready; now the system is in really good shape, but the money is gone."

To solve that problem, Athena is once again looking for outside funds. "What we are trying to do, and it is a continual challenge, is assist faculty members in locating [their own] curriculum development funds," says Earl Murman, Athena's present director. "Honestly, I don't think we have found that many sources of funding yet."





**D**igital Equipment Corp.'s offices in Maynard, Mass., were the setting for massive efforts to incorporate lessons from Project Athena into their products.

But there are a few shining examples of private funds at work. One such program is the Athena Language Learning Project, which secured a \$1,415,000 grant from the Annenberg/CPB (Corporation for Public Broadcasting) Project to help fund three large-scale systems for teaching foreign languages on workstations. (See *Athena Part II*, January 1989, page MIT 13.)

"Our project is especially interested in making education accessible to people who can't get to campus on a regular basis," explains Stephen Ehrmann, '71, the Annenberg officer supervising the project. "So a teaching method that allows students to work more on their own, both directly with the materials and using the capacity of the workstation as a communications device, is quite promising."

The Annenberg contract wasn't designed to help Project Athena fund curriculum development per se, Ehrmann notes. It was designed to fund a particular system for computer-assisted instruction, to be developed by a group of people at MIT who just happened to be using Athena.

Funds from the International Masonry Institute supported development by the MIT Department of Architecture of a system that allows students to draw buildings, calculate the construction costs, and

look at buildings with similar features using a video disc. That software was written for the IBM PC, so that it can be used by schools of architecture across the country.

**W**hat of the MIT undergraduates—the people for whom Athena is intended? On the job market, says Robert K. Weatherall, director of the MIT Office of Career Services, Athena's primary benefit has been to those who have worked for Athena as programmers and consultants—not for the students who have simply used the computers in their classes.

Prospective employers who know of Athena, Weatherall says, know only of its technical accomplishments. Companies who come recruiting at MIT—particularly those who already own equipment from more than one vendor—"would love to find" students who know how to build large-scale, networked computer systems using equipment from different manufacturers, Weatherall observes.

Athena's intention to improve undergraduate education at MIT is unknown. "I haven't heard anybody talk about that," Weatherall says. The outside world perceives MIT students as superior: Athena contributes to the intellectual atmosphere

of the Institute, but so does UROP and the senior thesis that most students must write. "The outside world doesn't ruminate on *why* MIT people are so good."

#### Athena Is Not the Only Show in Academe

From its inception, Athena was intended to be a contribution the general university education. It was not to be just a local phenomenon. That makes computer use on other campuses of more than passing interest to anyone involved with Athena.

MIT is the only American university that is trying to "do it all" in undergraduate computing: massive deployment of high-end, networked machines; system development; and creation of course-specific software. But several schools have undertaken collaborations with industry that focus on one or two of those areas, and many colleges and universities of all sizes have launched programs to give their students and teaching faculty access to personal computers.

IBM, for example, funded major workstation projects at two other universities at about the same time that it funded Project Athena. One, the Information Technology Center (ITC) at Carnegie Mellon University, set to the task of creating a network file system that would serve





**A**t left is the Watson Center for Information Technology at Brown University, where a project to put a workstation on the desk of every faculty member set the stage instead for a successful personal computer network.

campus workstations. The other, the Scholars' Workstation Project at Brown University's Institute for Research on Information for Scholarship (IRIS), investigated ways to involve faculty in using the machines.

But IBM's arrangements with ITC and IRIS were unlike those the company had with Athena. "IRIS and ITC were joint studies," explains Richard Parmelee. "There was a quid pro quo," which gave IBM exclusive rights to software developed by those projects. Indeed, IBM now sells both the file system and the programmer's tool kit that CMU developed. (IBM even required CMU to change the name of the file system from "Vice" to Andrew File System, AFS, "because some IBM marketing people thought that AFS was better," says Alfred Spector, director of the ITC.)

MIT wouldn't agree to a joint study, Parmelee says. "MIT takes very sternly its intellectual independence. It is not going to become a development organ for IBM or DEC."

MIT exerted its independence in other ways. At Brown, for example, steel screens on the windows and high-security locks on doors provided the security that IBM required before it delivered any unannounced products. But MIT would not accept delivery of any product it could not

display in the open, Parmelee says, so Athena did not receive the pre-release versions of the RT. Similarly, Athena had no pre-release equipment from DEC, says Ron Orcutt, Athena's executive director.

Athena's tough stand on off-the-shelf hardware and nonproprietary software was a key ingredient in the project philosophy, says Steven Lerman. By avoiding experimental hardware, Athena also avoided the expensive and time-consuming headaches of hardware development and debugging. And by demanding that neither IBM nor DEC assert intellectual property rights to programs developed at MIT, Athena ensured that its software could be distributed inexpensively. The policies at least made it possible that educational software written under Athena sponsorship could be adopted at other institutions—as textbooks written at MIT have been for generations.

#### Intentions of Grandeur

Whereas Project Athena has directed its energies toward many small efforts that added up to a single useful system, says Spector, CMU "embarked on a more grandiose effort at the beginning."

With the promise of \$4 million per year from IBM for at least seven years, ITC set

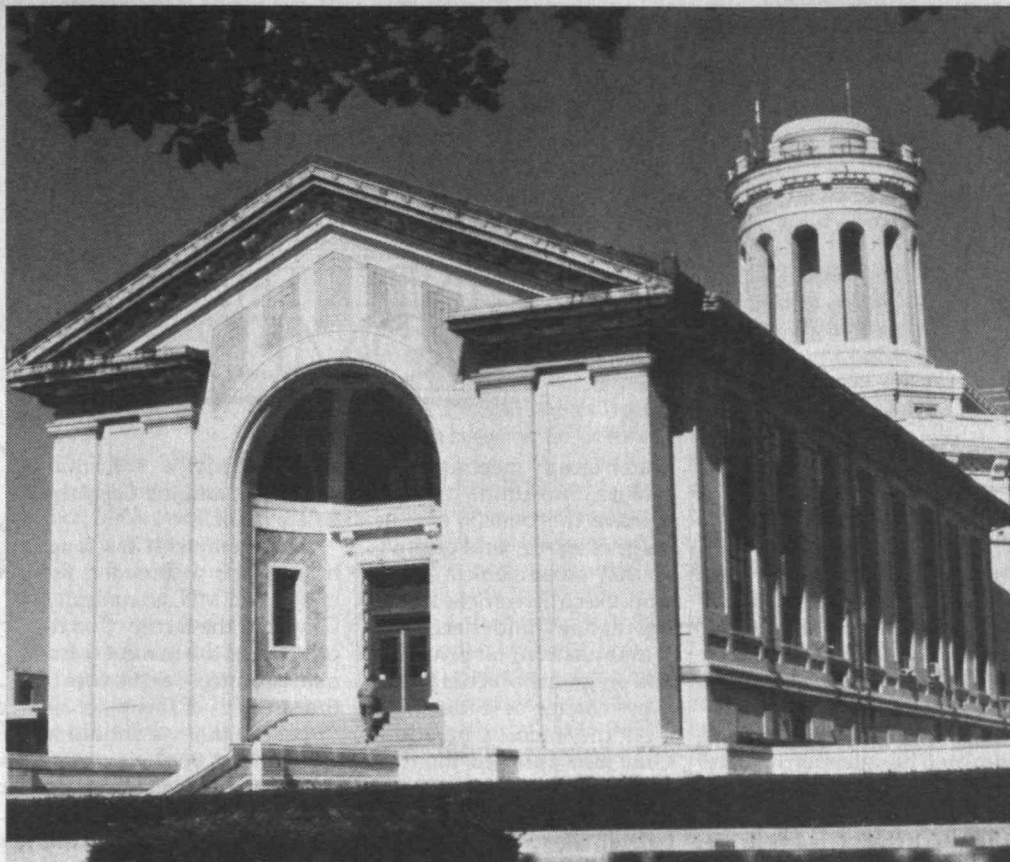
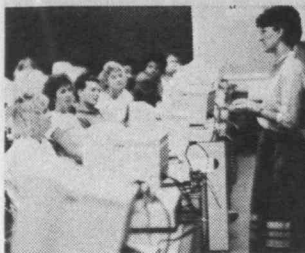
out in 1981 to build a file system that could support 10,000 machines, says Spector. What they created is a file system that shows promise of becoming the standard for networked workstations.

Today, the Andrew File System (AFS) is used throughout CMU—any AFS-programmed computer that is on the network can access files on any other. AFS presently supports SUN, VAX, and IBM machines.

"Our file servers are in use more widely than at MIT," says Spector, noting that the file servers operated by the CMU Psychology and Statistics Departments can be accessed as easily as files on machines in the Computer Science Department. At MIT, in contrast, file servers at the Laboratory for Computer Science, the Artificial Intelligence Laboratory, and the Media Lab cannot be accessed easily from Athena workstations.

Moreover, AFS was designed to be a nationwide file system, Spector says. Every file in every Andrew file server the country has a unique name that can be reached from any other Andrew file server that is connected to the Internet. AFS was also designed to overcome many of the problems that have plagued Project Athena, such as poor service to remote workstations connected by slow network links.





**C**arnegie Mellon University's tightly focused project with IBM created the Andrew File System, which can support any machine on the Internet network.

Students at CMU don't even need high-performance workstations to use AFS: "People on PCs can get access to the Andrew File System using something called PC server," Spector says. There are provisions for people on PCs and Macintosh computers to send and receive electronic mail, and Spector expects that Macs will have access to AFS in the very near future.

Every student at CMU automatically gets an account on Andrew with one megabyte of storage (compared with 600 kilobytes on Project Athena). And students who need more storage simply request it, says Robert Cosgrove, director of computing systems at CMU.

ITC, however, limited its efforts to system development and did not try to develop course-specific software to use on the network. Even though some software has been developed by other groups at CMU, says Spector, "there hasn't been a campus-wide effort on the scale of MIT's—not even close."

Despite the differences, both Athena and ITC may be growing toward a similar system, each project taking the best parts of the other's work. Recently, ITC modified AFS to use Project Athena's Kerberos authentication system. And AFS is being considered as a possible replacement for Athena's current file systems.

### Meanwhile, in Providence

Brown University's Institute for Research on Information for Scholarship (IRIS) occupies a turn-of-the-century converted house in Providence, Rhode Island. IRIS was started as a self-supporting research institute—"something new at Brown," says its director, Bill Shipp—to help bring computers into the educational process at a primarily liberal arts institution.

IRIS was the vehicle for the "The Scholars' Workstation," part of a \$20-million-project designed to put IBM workstations on the desks of all faculty members and encourage them to use the machines in their research.

"What we were trying to do was begin to articulate the type of computing environment—personal computing environment and campus environment—that we thought the faculty at Brown should have," says Shipp.

IRIS concentrated on the faculty, in the hope that teachers who used the computers themselves would introduce their students to the machines via mandatory assignments. But IRIS had problems.

"We were waiting for an RT that had a sufficient number of applications to meet people's demands," says Shipp. "The RT in the shape and form and with the soft-

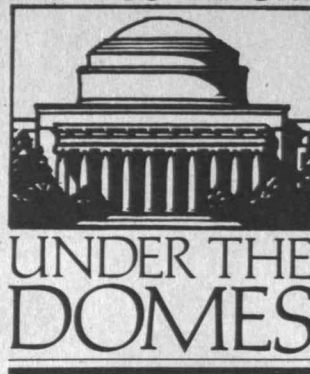
ware that was available [when IBM delivered it] . . . only met a very small fraction of the faculty's needs. There were no applications."

Frustrating as it was for the Brown community to work with those computers, lessons learned from the Scholars' Workstation Project enabled the university to set up the network it has today, Shipp says, with campus-wide file and print servers. But the machines on the network are Macintoshes, IBM PS/2's, SUNs, and MicroVAXes. "You walk through a lab at Brown that has RTs and most of [the machines] are sitting in the corner," Shipp reports.

**T**he outcome of all this experimentation, IBM's Carol Crothers believes, may be a "coming together" of low-end personal computers and high-end workstations into moderately priced machines with some high performance and network abilities.

"I think there is going to continue to be a need for very low-cost desktop computing, just to do word processing and generate reports," she says. And as far as the high performance machines go, she thinks that "you will see the leadership campuses like MIT and CMU continuing to push the frontiers." □





## Gray to Step Down

**P**aul E. Gray, '54, announced on March 4 that he will step down as president of MIT in July 1990, the tenth anniversary of his appointment. At the same time, David S. Saxon, '41, declared his intention to retire from his position as chairman of the Corporation, and it is expected that Gray will be named to replace him.

The search for a new president will be conducted by a committee headed by Carl M. Mueller, '41, who knows the territory well—he headed the search committees that recommended both Gray and Saxon, and was a member of the group that recommended Jerome Wiesner, Gray's predecessor. Professor Bernard J. Frieden, PhD'62, chairman of the faculty, will form a faculty advisory committee to the search committee.

The *Boston Globe*, which described Gray as "a plain-spoken electrical engineering specialist with the build and staying power of a fireplug," observed that he "has emerged recently as one of the most forceful voices in the growing chorus of demands for improvement in the math and science training given to American students." Gray intends to continue campaigning for improvements in primary and secondary science and math education.

Gray originally assumed the presidency with the intention of staying a decade. In discussing his decision at the

March faculty meeting, Gray said it's time for the Institute to have the benefit of "the surge of energy and creativity that accompanies a new chief executive officer and of the natural and necessary reexamination of priorities and programs which is part of every change of leadership."

At the faculty meeting, Gray also outlined the four areas he will concentrate on in the next year: the operating budget; efforts to understand, shape, and respond to "external forces which impinge on higher education generally and MIT in particular," and which emanate generally, he said, from the federal govern-

ment; MIT's human resources; and the *Campaign for the future*.

Consistent with his long-time efforts to broaden the mix of the MIT community, Gray told the faculty that he considered the Institute's human resources "at the core of the strength of this place. . . . I believe that we should in this coming year give more thought to ways in which the dimensions of human diversity that are evident in this community enrich [it], and we should give more attention to the kinds of policies and actions which enable us better to value and to benefit from that diversity." □

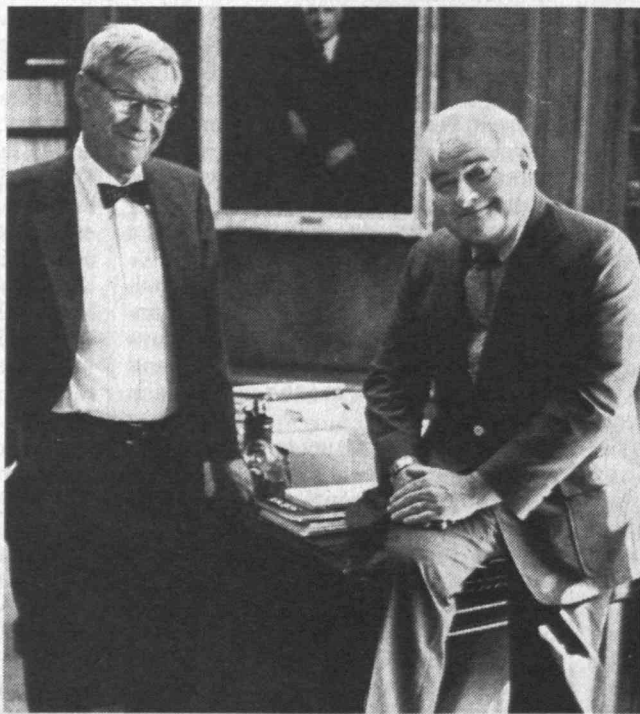
## Tsongas to Address 1989 Graduates

**F**ormer Massachusetts Senator Paul Tsongas, the newly appointed chairman of the state Board of Regents of Higher Education, will be the MIT Commencement speaker on June 5.

President Paul E. Gray, '54, in announcing the selection, noted that Tsongas' new position, along with his interest in the relationship between education, economic development, and societal well-being, "make it wonderfully appropriate for him to address this particular academic community."

"MIT has been concerned with those same issues for more than 128 years and is credited with contributing widely to economic development generally and to the Commonwealth in particular," said Gray.

Tsongas, a partner in the law firm of Foley, Hoag & Eliot, was named to his unpaid state post in January by Governor Michael Dukakis. The Board of Regents sets policy for the state's 29 colleges and universities, which enroll 180,000 students. In accepting the position, Tsongas linked the status of public higher education to the future of the United States as a major economic power. "I want to raise the question of whether this state wants quality first-class higher education or doesn't it," he said. "This country is facing a descent into second-class economic



The guard will change as of July 1990: David Saxon (left) retires as chairman of

the Corporation, and Paul Gray steps down as president to become chairman.





Paul Tsongas

status. The only way out of it is education."

In an interview reported in *The Tech*, Tsongas said his commencement speech will focus on the role of the United States in international economic affairs. In order for the United States to be a viable competitor in the world arena, Tsongas said, it must rely increasingly on "talent and brainpower" and less on natural resources. He said that MIT, with its commitment to excellence, is a model of the type of educational system this country must support. Although Tsongas went to Dartmouth and Yale, and his father to Harvard, two of his uncles were MIT alumni, giving him a strong sense of MIT's purpose and approach.

Tsongas, 48, served one term in the U.S. Senate from 1978 to 1984. He announced that he would not seek reelection after discovering that he had lymph cancer and has since undergone successful treatment for the cancer. At a relatively young age Tsongas is beginning to gain a reputation as an able and respected "elder statesman"—a vital role for which there are precious few candidates. □

## Spectacular Season for Winter Teams

■ **SWIMMING**—Junior Yvonne Grierson, from Ann Arbor, Mich., won the NCAA Division III national championship in both the 100-yard freestyle and the 100-yard butterfly to lead the MIT women's team to a best-ever 16th-place finish nationally. She earned All-America honors in four events, set Institute records in three, and was the second highest individual point scorer at the championship, which was held at the University of Notre Dame in South Bend, Ind.

■ **TRACK AND FIELD**—

Scott Deering, a senior from Plainfield, N.J., won the 35-lb. weight throw and set a facility record at Bowdoin College, site of the indoor nationals. He led the MIT men's track team to a best-ever tie for sixth place.

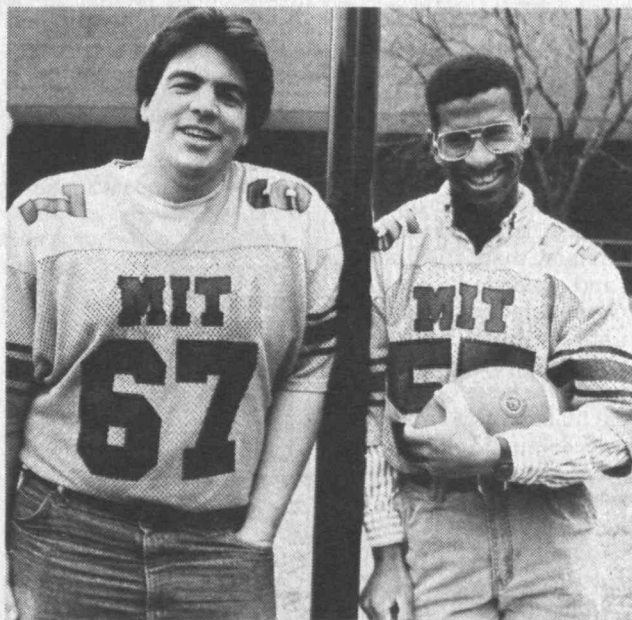
■ **MEN'S BASKETBALL**—In a 112-61 victory over Emerson College, the MIT Engineers scored the most points ever in a single game in the 82-year history of the team. With 29 points, senior Jay Fraser broke the 1,000-point barrier for his career, and moved into 11th place on the all-time MIT scoring list. The Engineers final record for the season was 14-8, the best since 1967-68. Not so surprising, then, that men's basketball coach Leo Osgood has been named the NCAA Division III New England Coach of the Year by

both UPI and the National Association of Basketball Coaches (NABC). Osgood was one of only eight Division III coaches in the country to receive the NABC honor.

■ **WOMEN'S BASKETBALL**—Head coach Corinne Gulas was named conference Coach of the Year at the New England Women's 8 Tournament, and junior center Maureen Fahey of Bannockburn, Ill., was named to the conference all-star team. Fahey finished the season as the conference's leading scorer and second in rebounding.

■ **WRESTLING**—Scott Schwartz, a 134-lb. senior from Duxbury, Mass., became the first MIT wrestler in five years to win a New England Championship. His season record was 26-0-0. The Engineers finished fifth, equalling MIT's previous best team finish. And honors came to a wrestling administrator: MIT Director of Athletics Royce Flippin was named New England College Conference Wrestling Association Man of the Year. He is a member of the NCAA Wrestling Committee.

■ **FENCING**—MIT placed first in every event in the New England Intercollegiate Fencing Conference Championships at Brandeis: graduate student Jae Sang from Flushing, N.Y., in sabre; senior T.K. Wong of Singapore in foil; and graduate student Joseph Harrington IV, '88, of Westboro, Mass., in epee. MIT finished second overall in the team standings. Sang and Harrington also qualified for the NCAA fencing championships held at Northwestern University at the end of March. Junior Alice Chang, from Alhambra, Calif., is one of four people named to the All-New England Team on the strength of her performance at the N.E. Champion-



*Their season under the glare of media attention didn't keep Bob Kupbens, '90, (left) and Darcy Prather,*

*'91, from earning honorable mention on the Pizza Hut Division III All-American football team.*



ship. Her first exposure to fencing was in a physical education class at MIT.

■ **WOMEN'S GYMNASTICS**—Freshman Lisa Arel of Lee's Summit, Mo., became the first Engineer to ever win the all-around title at the New England Division III Championships. She finished first on the balance beam and the uneven bars, second on the vault, and third in the floor exercises. Her chief opponent was the two-time defending champion. MIT placed second as a team at the meet, which was held in the DuPont Gymnasium. Arel went on to place fourth in the all-around competition at the National Collegiate Gymnastics Association Championship at the University of Wisconsin in La Crosse.

■ **SQUASH**—Senior Alec Litowitz from Chicago is the first MIT squash player ever to be named All-American. He won 12 consecutive matches to finish the season 17-6. Nationally, MIT ranked 17th for the year.

■ **SKIING**—The Engineers won the Eastern Intercollegiate Ski Association Division II Championship. They placed first in the four-event meet despite having their number-one Alpine skier fall in both the slalom and giant slalom. The 10-kilometer relay team of sophomore Terry Totemeier and seniors Tim Sulzbach and Steven Bull, all from Minnesota, defeated Harvard by 1:03 to win the event and the championship.

■ **FOOTBALL**—Two Beavers received honorable mentions in the Pizza Hut Division III football All-America Team. Sophomore inside linebacker Darcy Prather of Hazelwood, Mo., and junior offensive guard Bob Kupbens of Fairfax, Va., were selected by a nationwide panel of sports information directors. □

## Campaign Ahead of Schedule

The educational and research work under way at MIT has been sparking the philanthropic impulses of alumni and other potential donors, according to Vice-President and Treasurer Glenn P. Strehle, '58.

Strehle announced in February that the *Campaign for the future* had thus far brought in \$369 million in gifts and pledges. That figure represents two-thirds of the Campaign's \$550 million goal—an impressive achievement considering that the fund drive, launched in October 1987, does not wind up until June 1992.

In his presentation to the MIT Corporation, Strehle said, "This total has put us \$78 million ahead of where we projected to be at this time."

The picture is good for the Alumni Fund as well. As of mid-March, the FY89 Alumni Fund reported a total of \$10.2 million, more than 12 percent ahead of this date last year. That figure includes gifts from more than 20,000 alumni and alumnae.

With more than three years to go, the Fund has raised \$52.8 million toward its *Campaign for the future* objective of \$100 million. The Fund goal for 1988-89 is \$13 million, and at the current pace, reports Joseph S. Collins, managing director of alumni activities, this objective is likely to be exceeded.

Strehle said that one of the principal reasons for the strong progress to date "is that since the start of the campaign, many individuals have chosen to make the most significant commitments of their lives to MIT."

He noted that as of February, pledges and gifts from individuals totaled \$157 million. Some of those donors were attracted by the opportunity to endow professorships, scholarships, or other gifts named for themselves or for people they wished to honor.

Strehle remarked on the success of the life income gifts program, under which donors often make larger gifts than they could otherwise consider. The program provides for transferring to MIT ownership of cash, real estate, or securities, which produce income for the donors or other beneficiaries during

their lifetimes and revert to MIT when they die.

Also fueling the campaign's success, Strehle added, is an array of forward-looking research initiatives that have prompted corporations to make major contributions to MIT. One such initiative, the Leaders for Manufacturing Program—through which future leaders of industry earn simultaneous master's degrees in the School of Management and the School of Engineering—has brought in \$46 million in corporate support.

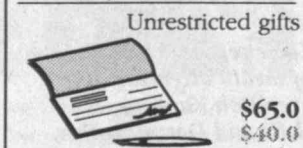
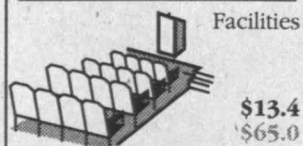
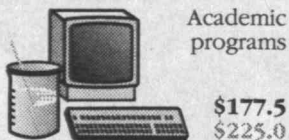
One piece of especially good news is the commitment to date of \$65 million—nearly 163 percent of the campaign goal of \$40 million—in unrestricted gifts. Close to \$45 million of that is already available for Institute use, while the rest comes in the form of pledges and life income plans.

In the months ahead, Strehle says, campaign leaders will be working to boost commitments toward the Institute's \$65 million goal for facilities.—Theresa Pease, from *Spectrum* □

### Campaign priorities

In millions of dollars

**Paid/pledged, Feb. 1989**  
Goal, 1992



## Pass/Fail on Faculty Agenda

In a discussion that could presage a significant controversy among faculty and students, the March faculty meeting considered a motion to change the current pass/no record grading policy.

Commonly referred to as "pass/fail," the existing regulations provide that grades are not recorded on the permanent transcripts of fresh-



men. Students who receive a grade of D or better receive a credit for that subject; the subject does not appear on the transcripts of students receiving grades of F.

The system was introduced in 1968, in an effort to reduce the academic pressure on first-year students and give them—particularly those from less competitive high schools—a year to adjust to MIT.

Among the unintended effects of the grading policy is the pressure freshmen feel to take all the Institute core requirements in math and science—difficult subjects by anybody's standard—when at least there is less grade pressure. If a student adds one or more subjects from the department in which he or she expects to major, the first-year schedule quickly becomes locked in. There is little opportunity for intellectual exploration and no time to sample subjects in alternative major fields.

Worse, some students who enter with weak backgrounds in mathematics are thrown immediately into a physics class that presupposes a certain level of math proficiency. But there is no way for them to upgrade their math before they tackle physics if they believe they must complete the required two terms of both subjects in the first year.

So, in an effort to introduce flexibility into the first year by allowing students to delay core subjects without penalty of grades, the Committee on the Undergraduate Program (CUP) has proposed changes in grading policy: Pass/no record would remain intact for the first semester of freshman year; but starting with the second semester, students would have the option of taking one subject per semester on pass/no record, up to a

maximum of seven subjects.

Under the proposed changes, a passing grade would be C or better. A student who receives a D could petition to have the credit and the grade recorded for the subject.

The proposal brought to the fore some aspects of pass/fail that faculty have been concerned about for years. For example, freedom from grades encourages some freshmen to load their schedules with as many difficult subjects as possible. In the process, in the opinion of many faculty members, the students degrade their performance in all subjects.

Pass/no record allows students who have received a D in a core subject—on which later subjects will build—to continue through the curriculum, but inadequately prepared. The most frequent reason given for academic failure among sophomores, Professor John Wyatt, '68, of electrical engineering and computer science said at the meeting, is that the student reacted poorly to pass/fail.

What's more, say many faculty members and students, few freshmen could take advantage of an opportunity to delay enrolling in the math and science core subjects, because they are prerequisites for many other subjects.

Members of the Undergraduate Association attending the faculty meeting commented that any tampering with pass/no record would turn up the pressure at an institution that already pushes its students too hard.

The faculty had the opportunity to amend or vote on the changes at the April meeting, which was held after *Technology Review* went to press. □



## Time to Add Biology to Science Core

At the first full faculty meeting to discuss proposed changes to the science core curriculum, there seemed to be general agreement that MIT is overdue in adding biology to the core and that the one semester of chemistry now required is really not adequate. But there were serious reservations about a strategy for addressing those concerns proposed by the Science-Engineering Working Group (SEWG) and endorsed by the Committee on the Undergraduate Program (CUP).

SEWG calls for MIT to develop a two-semester sequence of pilot subjects that combines chemistry, materials, and biology. If a rigorous evaluation shows the pilot subjects to be meeting their educational goals, SEWG recommends that they be

considered as replacements for the present chemistry requirement for the freshman class entering in 1991. At that time, the number of science distribution subjects would be reduced from three to two, in order to keep constant the total number of science subjects in the General Institute Requirement.

The proposals were expected to come up for a vote at the April faculty meeting.

More than one member of the faculty suggested that there was little doubt in anyone's mind that the new pilot subjects would be successful: The faculty designated to develop and teach the experimental subjects—Vernon Ingram of biology, Ronald Latanision of materials science and engineering, and Robert Silbey of chemistry—are enthusiastic, skilled, and committed teachers. But, said critics, MIT might not be able to maintain that high level of teaching for 1,000 freshmen year in and year out.

Proponents of the new program point out that all three subject areas share a common root in chemistry, and that the new subjects would be taught as a logical and coherent whole. But the majority of speakers at the March faculty meeting seemed to support individual subjects in chemistry and biology as the most appropriate vehicles for teaching the concepts proposed in the new syllabus.

Margaret MacVicar, '65, dean for undergraduate education and head of the CUP, said that the committee would consider a yes vote on this proposal at the April faculty meeting as support for adding biology to the core curriculum. The tripartite subjects would be just one way of implementing a biology requirement. □





## ALUM. NEWS

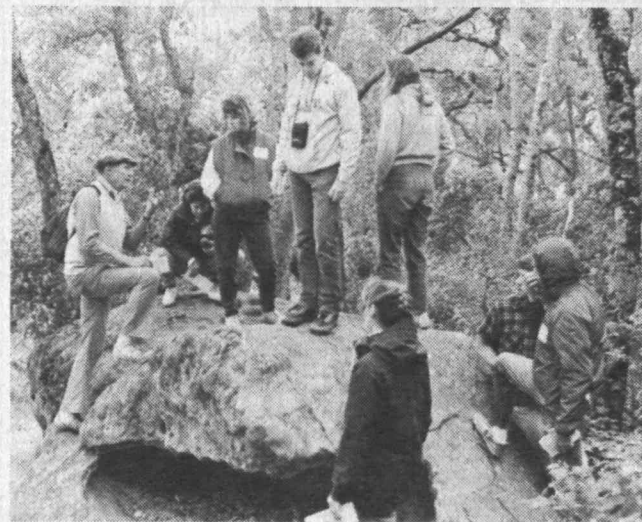
### Northern California Scholarship Fund Strong

**T**he MIT Club of Northern California won a Presidential Citation from the Association of MIT Alumni and Alumnae in 1987 for "sustained excellence," and it's not difficult to see why.

The club, which boasted a membership of more than 1,200 in 1988, helps MIT students find summer jobs, heightens MIT's profile in the Bay Area by presenting MIT Science Leadership Awards to outstanding third-year students in some 20 high schools, hosts one party for newly admitted students and another for all current MIT students, offers a rich array of lectures, tours, and social events spread over many locales for members, produces an area alumni/ae directory, and publishes a lively newsletter to keep members informed of all that.

Of particular note, however, is the club's scholarship program, launched by William E. Murray, Jr., '67, when he was club president in 1983-84, and strongly supported by successive club leadership. In the first year, the club provided a \$1,000 scholarship to a student from its bank account, a "pay as you go scholarship."

Then in 1985, the club established a \$10,000 scholar-



*Outdoor events like this hike through the Jasper Ridge Reserve are typical of the activities offered by the MIT Club of Northern California.*

ship endowment fund. An important player at that juncture was Elton Bell, '49, of Kidder Peabody; he suggested a strategy for holding the funds that did not require passing negotiable securities from hand to hand as club officers changed—a notion that had made everybody nervous.

In 1986, alumnae members of the Northern California club held a spectacularly successful art auction, and raised \$7,000 to fund a women's scholarship for the area. Other direct contributions and money from the club surplus (accumulated from dues and fees for programs) have

built the endowment to about \$50,000, enabling the club to offer five \$1,200 scholarships annually.

The Club of Northern California is not alone in this effort. The MIT Club of Chicago also built a scholarship endowment of about \$50,000, and scholarship programs are operated by the MIT Clubs of Southern California, Boston, Washington, D.C., and Mexico City.

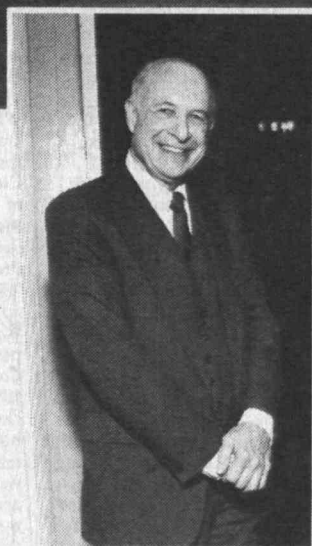
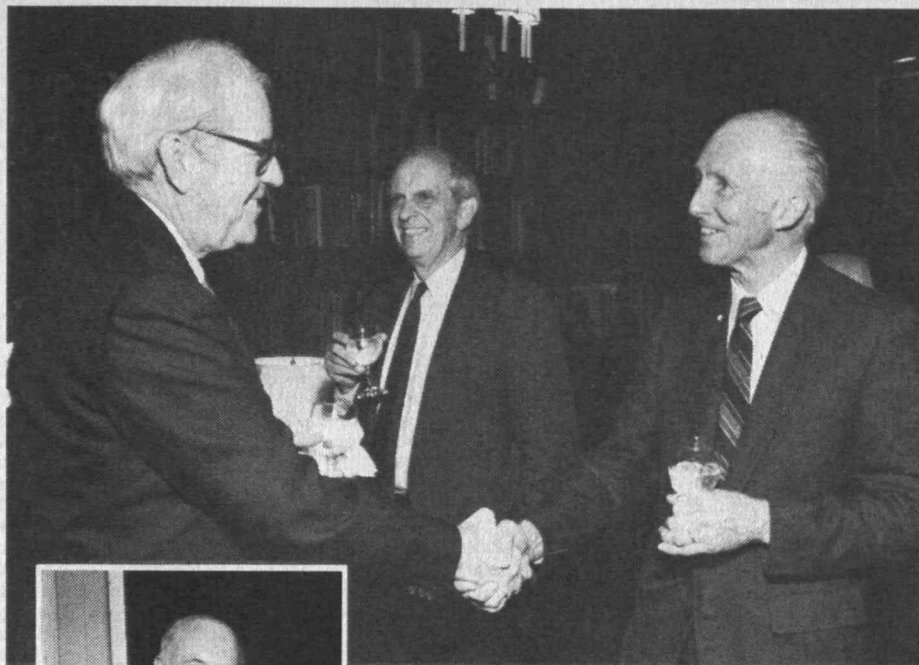
In addition to their obvious benefit to students, such programs strengthen the ties of distant alumni to the Institute, Bill Murray believes, and give them a solid reason to pay club dues. □



*The MIT Alumni Center of New York organized an evening of theater and a reception with playwright and MIT professor of literature A.R. Gurney and the cast of his latest play, "The Cocktail Hour." Left to right: Gurney, Nancy Marchand, Holland Taylor, Bruce Davison, and Keene Curtis. The New York Times cited "The Cocktail Hour" as an example of an off-Broadway production that many believe should be eligible for a Tony Award.*



*The reception preceding the Silver Stein Award dinner gave Joseph G. Gavin, Jr. '41 (top, far right) time to greet scores of family, friends, members of the Institute community, and colleagues from his days as president and COO of Grumman Corp., on hand to honor him as the 1989 award recipient. The Silver Stein is given annually by the MIT Alumni Center of New York to a member who has made a major contribution to his or her profession. Gavin was the head of the team that developed the Apollo Lunar Lander. There were several surprise guests, including Robert Cohen, from the National Research Council, Washington, D.C. (right); and Jeanne Olsen, Gavin's secretary at Grumman, who arrived from North Carolina (far right, with Dorothy Gavin).*



## FOR THE RECORD CONTINUED FROM PAGE MIT 3

What is needed is a required subject that comprises the best of MIT's progressive teaching on technology and its context, one that also emphasizes the systematic application of moral philosophy to engineering practice. Philosophers have long considered the moral implications of different systems for evaluating what is morally good. They have long been critical, for example, of utilitarianism (which demands "the greatest good for the greatest number"), an ethical system that tacitly lies at the heart of engineering.

Subjects in ethics offered by the Department of Linguistics and Philosophy do cover this and other relevant material. But they generally don't apply it to engineering in particular. Philosophy subjects could be designed, however, to prepare students to rigorously critique the ethical assumptions of material introduced in engineering subjects.

What is also needed is a direct consideration of such issues in engineering subjects themselves. Students should be encouraged—by their engineering professors—to

reflect upon the ethical nature of any given technical approach, rather than merely learn to use it.

There are few prospects of this happening in the immediate future, if only because today's faculty is not trained to think about such issues. But at least by encouraging today's students to criticize rather than merely compute, and by providing the analytical apparatus for doing so, we can look forward to a new generation of teachers capable of teaching more ethically aware curricula.

The hardest lesson of all is that there is no one way "to be good." The very title of the colloquium suggested that we can learn to be ethical in the same way we can learn mathematics. The role of education, however, should not be to teach rules of ethics, but to instill a mode of thinking that compels us to consider the ethical nature of everything we do, rather than allowing us to employ, robot-like, techniques with deep moral consequences of which we are only dimly aware. □





## COURSE NEWS

### I CIVIL ENGINEERING

In awarding its Horton Medal to **Peter S. Eagleson**, ScD '56, the American Geophysical Union said that hydrologists regard his work as exemplifying the application of "new approaches to old problems." Eagleson, the Edmund K. Turner Professor of Civil Engineering at MIT, is widely known for his work on flood frequency and rainfall networks. He introduced quantitative techniques of fluid mechanics into the science of hydrology and, by linking probability studies with physical modeling, has had a profound influence on the field, the AGU said. His recent work has focused on global-scale hydrology, examining the effect of land hydrology on atmospheric circulation. The Horton Medal honors outstanding contributions to the geophysical aspects of hydrology. . . . **Reynold K. Watkins**, SM '47, has won the ASCE 1988 Stephen D. Bechtel Pipeline Engineering Award for his achievements in water supply-disposal and buried structures; his contributions to the advancement of pipeline technology through the publication of numerous articles and papers; and his participation in Pipeline Division activities since 1952.

**Michael D. Meyer**, PhD '78, has received the 1988 Harland Bartholomew Award for his contributions to transportation planning and research. He is a professor at MIT and director of the Massachusetts Bureau of Transportation Planning and Development. . . . **Ray W. Clough**, ScD '49, professor emeritus of civil engineering at UC/Berkeley, has been elevated to Honorary Member of the ASCE. He is a leading researcher and educator in the field of structural and earthquake engineering, and has been recognized for his pioneering work in the development of the finite element method and its application to civil engineering problems. . . . **Michael A. Collins**, PhD '70, is co-winner of the 1988 ASCE NEWS Correspondent Award for his monthly Pipeline Division column in the ASCE NEWS. He teaches water resources engineering, hydrology, hydraulics, and water management & policy courses at Southern Methodist University, where he has been a full professor since 1978. . . . The ASCE's Middlebrooks Award has been granted to the three authors of "Test Fill at Chek Lap Kok, Hong Kong," which appeared in the *Journal of Geotechnical Engineering* in February 1987. Two of them are **Demetrios C. Koutsoftas**, CE '72, and **Roger Foott**, ScD '73. Koutsoftas is an associate at Dames & Moore and Foott is president of Roger Foott Associates, Inc., both in San Francisco.

From Latham, N.Y., **Joel P. Brainard**, SM '67, writes that he has shifted the focus of his professional work to the economics of the regulation (and deregulation) of telecommunications companies. He now has three children. . . . **Col. Edward R. Ardery**, SM '49, is the manager of construction for the Potomac Electric Power Company in Washington, D.C. . . . **Michael D. Dettinger**, SM '79, will be attending UCLA next fall to complete the coursework toward a PhD in atmospheric sciences as part of the U.S. Geological Survey training program. He has a son and a

daughter. . . . **Stanley White**, CE '76, is now managing two companies—Ocean and Coastal Consultants and Fairfield Dock. Both are involved in the engineering and construction aspects of the surge in waterfront development. . . .

**Richard R. Pikul**, CE '67, began his own engineering firm last year, specializing in structural investigations, evaluations, and troubleshooting. . . . As chairman of Zaleski Sherwood & Co., **Michael Zaleski**, SM '71, is a principal in corporate acquisitions. He currently owns seven companies involved in retailing, PCs, food, glass, health financial services, and consumer electronics—with combined sales of more than \$700 million.

**Ru-Liang (Leon) Wang**, ScD '65, chairman and professor of civil engineering at Old Dominion University in Norfolk, Va., attended the 9th World Conference on Earthquake Engineering in Tokyo, Japan last August. He presented a paper and chaired a session on "Lifeline Earthquake Engineering." Prior to the conference, he was invited to lecture at several universities in Seoul, Korea. . . . "Last July I became the operating unit manager of the Waste Management Operating Unit at Woodward-Clyde Consultants' Oakland office," writes **Ulrich Luscher**, ScD '63, from California. "Have been working here since leaving MIT in '67; my title is senior managing principal." . . . **Tom Maddock**, SM '51, is still president/CEO of Boyle Engineering Corp., headquartered in Newport Beach, Calif. He is working on a number of water resource projects in the U.S. and is starting work on a large AID-financed water/wastewater project in Egypt. . . . **Robert E. Lathlaen**, SM '46, is an adjunct professor at NYU teaching construction management. Last October he was elected chairman of the National Construction Industry Advisory Committee of the American Arbitration Association. . . . **Elliot Steinberg**, SM '80, recently joined the Cambridge consulting firm of Haley & Aldrich, Inc., as senior engineer. . . . **Chi-Kuo Mao**, PhD '83, has been appointed director general of the Tourism Bureau in Taiwan's Ministry of Communications.

### II MECHANICAL ENGINEERING

**Dwight E. Beach, Jr.**, SM '65, writes: "I presented the business plan for my company, Houston Engineers, Inc., to the MIT Enterprise Forum of Texas last year. Enterprise Forum has made excellent contributions to the Houston economy. I was most fortunate to attend the Stanford Executive Program last summer. . . . **Peter H. Medd**, PhD '88, is an assistant professor of mechanical engineering at Purdue University. His first child, a boy, was born a year ago. . . . **Michael B. Packer**, PhD '80, sends word that he is a vice-president of the MAC Group, a general management consulting firm in Cambridge, and heads its international information consulting practice. But, he says, "my focus is on curing my hooks and slices on the golf course." . . . **Michael Feldstein**, SM '66, has recently joined Reflection Technology, Inc., of Waltham as vice-president of engineering.

"This is a start-up company developing a revolutionary full-screen miniature information display called the 'private eye,'" he writes. "Its early investors include Jerome Wiesner." . . . In Billerica, Mass., **C. Frederic Young**, SM '60 has been promoted from vice-president of finance & operations to president of Cognition, Inc. He takes over the reins from **Philippe Villers**, SM '60. . . . **J. Stanley Cobb, Jr.**, SM '47, is the vice-president-elect of ASME's Region IV. . . . From North Carolina, **Beal Marks**, SM '47, writes "We've just completed our new home on Bogue Banks, and anticipate less maintenance and a more comfortable life-style."

Recently named Fellows of ASME: **Daniel Whitney**, PhD '68, of the Mechanical Design Directorate's Automation Technology Section at the Charles Stark Draper Laboratory; **Jack B. Chaddock**, ScD '55, professor and associate dean of the Duke University School of Engineering; **Steven Dubowsky**, MIT professor and associate director of the Laboratory for Manufacturing and Productivity; and **Frederic Yui Ming Wan**, PhD '65, professor and chairman of the department of applied mathematics at the University of Washington, Seattle. . . . Basic Books, Inc. has published *Liability: The Legal Revolution and its Consequences* by **Peter Huber**, PhD '76 (September 1988, \$19.95) Huber has taught at MIT and clerked for Justice Sandra Day O'Connor—he holds a law degree from Harvard as well three engineering degrees from MIT. A law professor writes in praise: ". . . a wise and witty book about one of our nation's pivotal problems—the mangled method we lawyers have devised to pay (largely ourselves and other 'camp followers') when people get hurt. And he offers some promising solutions." Another calls the book "brilliant, provocative, original, and iconoclastic. It should be read by everyone interested in (or appalled by) our legal system."

The Alumni Association has received word of the death in May 1988 of **Wayne B. Grieve**, '43. He had lived in Pierson, Iowa, for the last 15 years with his sister-in-law and nephew.

### III MATERIALS SCIENCE AND ENGINEERING

**Truc-Chi Huynh**, PhD '87, and **Will Perrie**, PhD '80 (XIX), were married in July 1987 and now reside in Halifax, Nova Scotia. Chi is on maternity leave from the Atlantic Research Laboratory of the National Research Council of Canada, following the birth of their daughter. Her husband is working at the Bedford Institute of Oceanography. . . . **Martin Weinstein**, ScD '61, is the chairman and CEO of Chromalloy Gas Turbine Corp., a major supplier of materials, coatings, and other advanced metallurgical services to jet engine manufacturers and users. He reports that the 42 U.S. divisions and seven foreign locations had combined sales of "\$600 x 10<sup>9</sup> for 1988." . . . The American Vacuum Society has chosen **David W. Hoffman**, PhD '66, a research staff scientist in the materials science department of the Ford Motor Co., as its new president-elect, effective in 1990.



# IV ARCHITECTURE

"Last August I was appointed adjunct professor with the Department of Architecture at U.C. Berkeley," writes **Nezar Alsayyad**, SM '81. "I also finished editing *Dwellings, Settlements, and Tradition* which will be released by the University of America Press this spring. Colleagues interested in the subject of traditional settlements should send us a note and we will place them on the mailing list of IASTE, our newly established International Association for the Study of Traditional Environments." . . . **Donna Duerk**, MAR '80, reports that she is on sabbatical from January to September and is working on the first draft of a textbook on architectural programming—the problem-definition phase of design. . . . Last fall **Peter Droege**, MAR '78, taught a two-week design studio in Course IV, and entered an international urban design competition with 12 students. Their team won second place in the "Design Vision" competition. . . . **Joongsub Kim**, SM '87, is project designer for Allen, Demurjian, Major & Nitsch in Cambridge. Kim recently received an art/architecture award in an international competition—"The Project DMZ"—funded by the NEA and the New York State Council on the Arts, and exhibited at the Storefront for Art & Architecture in New York City.

Queen Elizabeth II's New Year Honors List included **N. Keith Scott**, MAR '55, chairman of the international architectural firm Building Design Partnership (BDP), headquartered in Preston, England. Scott was named a Commander of the British Empire (CBE), which is the third highest honor (behind barony and knighthood) bestowed by the queen as an expression of gratitude for outstanding contributions and service. . . .

**Samuel C.M. Wang**, MAR '62, is the design principal for Cannon Corp. (a 400-people A/E firm) on the Commonwealth Armory site housing/mixed-use project for Boston University in association with Mintz Assoc. The project includes 1200 beds plus retail, recreation, and parking facilities.

**M. Wayne Stoffle**, MAR '40, writes: "Since I closed my architectural office, I practice fishing in Alaska, Canada, but mostly Louisiana. In my spare time I try to figure out my new IBM 80-31. Occasionally I indulge in the wonderful crawfish etouffe at the Bon Ton in New Orleans.

Olson Lewis Architects of Manchester, Mass., have announced the promotion to associate of **James Heiberg**, MAR '79, and **Bradley Shotola**, MAR '83. Some of Heiberg's projects include the Royal Sonesta Hotel expansion in Cambridge, a new casino in Aruba, and a luxury hotel in New York City. Shotola was on the design team of the award-winning Charette New Haven project and is now working on a new hotel in Curacao and the renovation of an historic building in New York's Soho district.

The Alumni Associate has received word of the death on November 16, 1988, of **Antonio C. Kayan**, MCP '42, in Fort Myers, Fla. He was 77, and had spent much of his life traveling around the world as an international consultant on urban development and low-cost housing. The United Nations and the Puerto Rican government hired him for advice on the clearance of slums, housing developments, and planning. In the words of Kayan's wife, Evelyn, "He tried to make life better for those who had very little."

# V CHEMISTRY

**E.J. Corey**, PhD '51, the Sheldon Emery Professor of Chemistry at Harvard, is one of two American professors named as winners of the 1989 Japan Prize. He will receive the Medicinal Science Award and 50 million yen, or approximately \$400,000, from the Science and Technology Foundation of Japan for his contributions to synthetic organic chemistry that have resulted in the syn-

thesis of therapeutic bioorganic substances. Corey was the first to synthesize prostaglandins—key regulatory substances—and also developed chemical pathways for the synthesis of more than 60 complex naturally occurring organic molecules. Among these products—including hormones, toxins, terpenes, and antibiotics—is erythronolide, the basic nucleus of the antibiotic erythromycin. . . . **Ernest R. Gilmont**, PhD '56, has been elected president of the Societe de Chimie Industrielle, American Section—a Paris-based international organization that aids and encourages the use of scientific and engineering developments by the chemical industry. Gilmont is a senior consultant with Arthur D. Little, Inc. . . . MIT Professor **Sylvia T. Ceyer** has been awarded a continuing NSF grant to support a project under her direction entitled "Dynamics of Molecular and Dissociative Chemisorption." Originally approved for three years, the grant has been extended an additional two owing to the special creativity and outstanding scientific and technical progress achieved thus far by the research. **Katharine B.J. Schowen**, PhD '64, sends word that her husband **Dick**, PhD '63, received an honorary doctorate in natural science last December from the Martin Luther University at Halle-Wittenberg, East Germany. . . . **Byron G. Hays**, PhD '64, is R&D director, special projects, in the Coatings & Inks Division at BASF Corp. . . . **Evan T. Williams**, PhD '63, has been appointed the Schwartzman Professor of Chemistry at Brooklyn College. . . . From California, **John T. Viola**, PhD '67, writes: "With space shuttle flights resumed, we at the Rockwell Science Center are looking forward to flying an experiment on floating-zone crystal growth in low gravity, scheduled to fly in April. This research on space processing is one aspect of my work on HgCdTe as a very interesting semiconductor compound that we hope to develop into infrared detectors for a wide range of applications." . . . At the GM



*We'll take "Generalists" for \$500, Alex. Hmmm, Leah Greenwald, MAR '78. Let's see . . . Oh, yes—What MIT alumna won a spot in the 1988 Jeopardy! Tournament of Champions last fall after winning the second biggest sum all year on the daily game show?*

*That's Leah (right), with Jeopardy! host Alex Trebek at the \$100,000 championship. She gave it her best shot, but the competition in the tournament was stiff and their reflexes quicker than hers. But she still gets to keep the \$58,802 she won earlier.*

Research Laboratories in Warren, Mich., **Dexter D. Snyder**, PhD '68, is senior staff research scientist and section manager for corrosion science and surface coatings.

**Robert W. Davison**, PhD '50, a research scientist for Hercules, Inc. in Wilmington, Del., has been named a Fellow of the Technical Association of the Pulp and Paper Industry (TAPPI). His numerous contributions to the industry include studies of surface chemistry phenomena, the mechanism of resin sizing, and the application of strength additives. . . . **Arnold M. Schwartz**, PhD '74, has been promoted to associate professor of pathology with tenure at George Washington University Medical Center in Washington, D.C. . . . In July, **Ronald A. Hites**, PhD '68, is teaching his 13th annual course in environmental applications of gas chromatographic mass spectrometry (GC/MS) at Indiana University in Bloomington. Hites, professor of public and environmental affairs as well as chemistry at IU, emphasizes data interpretation and practical techniques that can be used to solve real-world problems, such as determining the precise contents of abandoned drums of hazardous waste.



**E.R. Gilmont**

**R.W. Davison**





The MIT Department of Architecture was awarded a challenge grant of \$42,000 last fall by the Massachusetts Housing Partnership for a proposal to help community groups develop affordable housing.

Professors Nabeel Hamdi and Reinhard Goethert, MAR '70, and researcher Neal Mongold, SM '88, are preparing a planning assistance kit (PAK) that will include a workbook and a series of "gaming" exercises designed to assist community organizations in project planning, implementation, and management. The methods outlined in the workbook also will be used in workshops to be held with community development corporations and tenant organizations.

The MIT proposal was based on a "small is beautiful" concept that is gaining acceptance and support among housing specialists and housing policy analysts. Their belief is that community/user control in the development process is important to ensure successful low- to moderate-income housing projects. When design and development decisions are made by those close to the situation, this thinking goes, the solutions are more appropriate. However, such community-based organizations often need considerable assistance to become effective housing planners.

The work under the MIT challenge grant seeks to empower low- and

*Neal Mongold, Reinhard Goethert, and Nabeel Hamdi (left to right) display their housing game, one of six parts of their planning assistance kit. The game is designed for play by community development organizations to help them discover different solutions to housing problems.*

moderate-income people by adding to their knowledge of resources and alternatives and by demonstrating a model for community participation.

Goethert and Hamdi have conducted many similar programs in developing nations, including Sri Lanka, Chile, and Thailand. The two have developed an approach called "microplanning" that enables local residents to make planning decisions rapidly.

After a highly competitive review process last summer, the Massachusetts Housing Authority awarded 25 challenge grants to a variety of groups and individuals. The Massachusetts Executive Office of Communities and Development is hoping to use the innovations developed under the grants as models for similar developments throughout the state.

Hamdi and Goethert see their grant as a first step in the establishment of a Massachusetts-based resource center or "shop front" that can offer training and technical assistance to community nonprofit housing organizations. □

tions systems. . . . MIT Professor William Schriber is one of 10 people named by Commerce Secretary C. William Verity to a special advisory committee to examine the impact of Advanced Television (ATV) on the future competitiveness of the U.S. television industry. . . . Donald J. Atwood, SM '50, second in command at General Motors Corp., has been named by President Bush to be the No. 2 man at the Pentagon, responsible for the Defense Department's day-to-day operations. . . . Last May Charles H.R. Camppling, SM '48, was awarded the Distinguished Service Award from Queen's University in Kingston, Ontario, for his many contributions to the school. His citation reads in part: "A front-line scholar and award-winning communications researcher, specialist in digital systems and non-linear magnetics, councillor to engineering institutes, and a teacher whose intelligence, caring, and dedication have brought distinction to his alma mater and placed an indelible stamp, through his students, on Canada's technological future." Camppling reports that last September he was appointed professor emeritus of electrical engineering ("salary zero!") and adjunct professor of E.E. ("salary very modest!") at Queens.

Alfred K. Susskind, SM '50, died on December 10, 1988 of cancer after a short illness. He took early retirement from Lehigh University in 1987 and was a program director (rotator) with the Division of Microelectronics-Information Processing Systems at the National Science Foundation. He resided in Bethesda, Maryland. . . . Leon "Jake" Kraft, SM '49, passed away on January 9, 1989, after a long illness. He was one of the original staff members of MIT's Lincoln Lab in Lexington, where he worked for 38 years. During that time, he was involved with the Venus Project, and was responsible for discovering the Kraft Inequality, an important theory in communications. He retired in 1985.

#### VI-A Internship Program

This is being written in February, at the start of the Spring Term, just after the "VI-A Orientation Lecture" which many of you will remember kicks off the annual selection process for a new VI-A class. Director Kevin O'Toole, NE '57 (XIII), tells me that approximately 130 students attended this year, with 30 to 40 others picking up literature. This is an excellent response for an EECS sophomore class numbering slightly less than 250. Our participating companies should have some excellent choices again this year.

You may have read in the national news of the research Professor Amar G. Bose, ScD '56 and colleague William R. Short, ScD '80 have done on a different technique of FM broadcasting known as "FMX." The results of their research, and a demonstration, were given at a January IAP lecture to a capacity audience in the Bartos Theater in the new Wiesner building. Basically their research contests the claims of the FMX proponents that their system improves multipath stereo reception. Seen at the lecture was VI-A grad Charles Hieken, SM '52, attorney with Fish & Richardson in Boston.

Frances T.P. Lam, a current VI-A student, is one of 1989's Burchard Scholars, an MIT program to bring together distinguished faculty and promising juniors and sophomores demonstrating excellence in some aspect of humanities and social sciences.

The semi-annual VLSI Research Review of the Microsystem Research Center was held December 19, and a number of VI-As were participants: Mathews M. Cherian, Kathy S. Krisch, SM '88, Kyong-Yop (Ken) O, Patrice M. Parris, SM '86, Satish B. Rao, SM '87, Mark W. Reichelt, SM '87, Thomas R. Shiple, SM '87, Elias D. Towse, PhD '87, and Charles A. Zukowski, PhD '85.

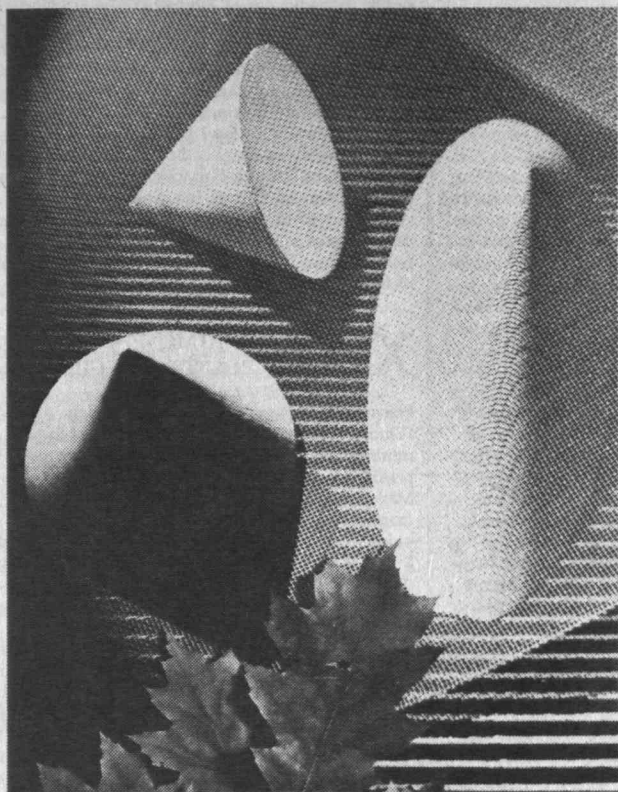
From the winter edition of *Perspective*, a publication of the College of Engineering at the University of Wisconsin/Madison, we learn that the students of the EECS department there elected Denise D. Denton, PhD '87, as co-winner of the

## VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

The Optical Society of America has awarded its 1989 John Tyndall Award for distinguished contributions to fiber optics technology to Steward E.

Miller, SM '41, Bellcore consultant and former director of lightwave telecommunications research at AT&T Bell Laboratories. He is cited for foresight, dedication, technical contributions, and pioneering leadership in building the broad foundations for today's fiber optic telecommunica-





**T**his spring, the Clarence Kennedy Gallery in Cambridge showed a retrospective of the photographs of Gyorgy Kepes, founder of the Center for Advanced Visual Studies (CAVS) in the MIT School of Architecture and Planning.

The exhibit included his earliest black-and-white photographs, made in Germany in the 1930s, through his most recent color images created with a 20x24-inch Polaroid camera. The photograph to the left, *Contrasts*, is an example of the latter (picture the leaf a deep crimson, and the rest a pale rusty pink).

Kepes' early photographs made use of a wide variety of elements, including light tracings, conventional geometric signs, and common objects such as bread, eggs, leaves, and coils. Later works were often made in

the darkroom, without the use of a camera.

After seven years working with Laszlo Moholy-Nagy, founder and director of the photographic department of the Bauhaus in Weimar, Germany, Kepes emigrated to Chicago in 1937, where he directed the Light and Color Workshop at the New Bauhaus.

Following the publication of his book, *Language of Vision*, in 1944, he was invited to MIT to teach courses in visual design. From 1945-1977, Kepes designed kinetic light installations, organized thematic exhibitions, resumed painting, and nurtured the students of CAVS.

Kepes' work is represented in museum collections around the world—and he will soon be honored in Hungary with a museum in his own name.

Professor of the Year Award—to which we add our own congrats. The award was based on "knowledge of material, clarity of presentation, ability to generate interest and rapport with the students." In 1987, Denice was awarded a prestigious Presidential Young Investigator Award by the National Science Foundation.

Watching the *Ten O'clock News* on Boston's PBS channel January 3, I saw an item on robotics which included views of the MIT AI Lab. As commentator there appeared our Anita M. Flynn, SM '85, explaining some of the demos.

In January, MIT's Office of Career Services sponsored talks aimed at students in the humanities and social sciences. Two of the speakers were Glenn A. Hopkins, SM '88, research associate, the LEK Partnership in Boston, and Earl C. Yen, '88 of Bear, Stearns & Co., Boston.

In July, Charles A. Kaminski, EE '72, and family will be moving to their new home in Wellesley, Mass. It will be great to have them as my new neighbors. Charles is with Baring America Asset Management Co., Inc., in downtown Boston.

With the recruiting season getting into full swing a number of VI-A's will be on campus as company representatives. Several we've met already: John K. Bartholomew, SM '88, and Geoffrey J. Bunza, PhD '81, from Mentor Graphics in Beaverton, Ore., where Geoff is now a division general manager.

Steven L. Rohall, SM '88, was here from Bellcore to consult with people in the X-Window Group in conjunction with his work. He said he is also involved with MIT's Educational Council in the New Jersey area interviewing applicants to the Institute. He informed me that Victor L. Ransom, '48, has recently retired; Victor assisted VI-A at Bell Labs for many years.

I had a nice reunion during Geoff Bunza's visit with Steven L. Bates, EE '76, with GenRad, joined us for an evening dinner at the former Allston Depot (now called "Sport Depot"); additionally interesting as Geoff and I, both RR buffs, saw lots of freight and passenger traffic in the Allston/Brighton yards adjoining the station.

On campus for a committee meeting concerning MIT/Lincoln Laboratory relations, Vincent W.S. Chan, PhD '74, representing Lincoln Lab, stopped by the office for a short visit during a break in that meeting.

John E. Koegel, SM '81, (formerly Buford) came by while visiting Project Athena in connection with his work at the University of Lowell. John was at the University of Denver where he did doctoral work on a project supervised by the University of Graz in Austria. He received a PhD from Graz. John and his family now live in Wellesley, Mass., and his wife is employed at the Codex Corp. in Canton.

The next issue will bring news of all our VI-A friends who join us for the annual meeting and dinner and the two hectic days of recruiting.

Keep us posted on any of your own activities—you'd be surprised how many grads tell me they read this article and that it's the first place they turn to in each issue. A good way to keep in contact with friends and classmates!—John A. Tucker, Special Assistant to the Department Head for VI-A and Lecturer, MIT, Room 38-473, Cambridge, MA 02139.

## VII BIOLOGY

The 1988 Louisa Gross Horwitz Prize, given annually by Columbia University for outstanding research in biology or biochemistry, was awarded to MIT Professor Phillip A. Sharp and Thomas R. Cech of the University of Colorado at Boulder. The two will share the \$22,000 prize for their work with RNA. Sharp was honored for his elucidation of how RNA is assembled, by a kind of "cut and paste" method, to carry out its vital functions in the assembly of proteins. Cech discovered that RNA is not merely a messenger for DNA, the cell's genetic storehouse, but in fact possesses surprising abilities as a catalyst in cellular processes. . . . Vernon M. Ingram, the internationally respected biochemist known for

identifying the single genetic defect that causes sickle cell anemia, has been named the John and Dorothy Wilson Professor at MIT. In addition to his many scientific contributions, Ingram runs a freshman advising seminar each year, is the housemaster of Ashdown House, has organized a summer course to teach biology to faculty members from other disciplines, and has served on numerous committees since he began teaching at MIT in 1958. He is also known for his macro closeup color photographs of flowers.

Leo Cravitz, DPH '44, died suddenly on December 31, 1988, in Rochester, N.Y. Before serving at the Medical Research Institute in Bethesda, Md. as a naval officer in World War II, Cravitz was a research associate in the Boston Health Department, where he pioneered in the development of effective immunizing vaccines for pertussis (whooping cough). Following the war he joined the staff of Rochester General Hospital, and from 1947 to 1986 he was chief medical microbiologist and hospital epidemiologist there.

Akiko Higa, PhD '64, passed away on October 1, 1988. Her husband Masanori sent word to the Alumni Association that she had begun suffering from the rare disease myasthenia gravis last June and was hospitalized in August. She was busy writing a paper for publication until just a few days before her death, and although no one suspected that her illness would proceed so rapidly, "one small consolation is that she was able to finish the paper."

## VIII PHYSICS

MIT Professor Anthony P. French has received two honors for his contributions to the teaching of physics—the Bragg Medal and Prize conferred by the Institute of Physics in London, England, and the Oersted Medal of the American Association of Physics Teachers (AAPT). The Institute cited French's "outstanding series of undergraduate textbooks and his work with the International



Commission on Physics Education," which he served as chairman in 1975-81. The AAPT has awarded the Oersted Medal since 1936 for outstanding contributions to physics education. French was a member of the AAPT's Commission on College Physics in 1966-71, and president of the association from 1985-86. . . . Fellow department member **Vera Kistiakowsky** has been elected to the Senate of the Phi Beta Kappa Society for the term 1988-94. . . . **Edward Cohen**, ScD '71, is the president of the MIT Club of Ottawa, Canada. Although it is less than two years old, the club has managed to attract 20 percent of the alumni and alumnae living in the Ottawa area, and has had several successful programs focused on such topics as the Daedalus project and the application of systems analysis to the planning of public works. . . . **Robert L. Mozzi**, PhD '68, has been named a consulting scientist at Raytheon Co. The promotion to Raytheon's highest scientific level was awarded in special recognition of outstanding research achievement over a long period of time.

**Irl W. Smith**, PhD '73, reports that he is currently managing the Digital Technology Lab at Raytheon Co.'s research division in Lexington, Mass. He is "engaged in development of ultra-high-speed digital circuitry (Si and GaAs) and embroiled in the controversy of 'charge conservation' in FETs." . . . **Jeffrey Norman**, PhD '88, has taken a position as assistant professor of physics at Vassar College. . . . **Sol Aisenberg**, PhD '57, writes that he is "founder and president of Data Associates, a consulting and product development company. Active in development and applications of diamond-like carbon and in thin film technology. Also medical devices, electro-optics, instrumentation, and special materials. Invents solutions to client problems and also licenses inventions developed by Data Associates." His company is located in Waltham, Mass. . . . **Nelson L. Alpert**, PhD '48, recently received from the Conn. Valley Section of the American Association for Clinical Chemistry (AACC) their Seligson Golden Award for service to profession and section, and from Alliance of Northeastern Sections of the AACC a special plaque for contributions to profession. His monthly mini-journal, *Clinical Instrument Systems*, is recognized internationally, he reports. . . . The Institute of Electrical and Electronic Engineers has elected **Robert D. Maurer**, PhD '51, a Corning Glass Works research scientist, as a Fellow in the Society, along with his colleague, Donald B. Kack. In 1970, the two produced the world's first optical fiber suitable for telecommunications (20 dB/km light-loss transmission). Their work made optical light transmission possible in telecommunications, computers, and process controls, and helped create a \$3 billion industry. Since then they have been involved in research that has improved the light-loss levels in Corning optical fibers by two orders of magnitude.

The American Physical Society has awarded the 1989 W.K.H. Panofsky Prize jointly to MIT Professors **Jerome I. Friedman** and **Henry W. Kendall**, PhD '55, and to Richard E. Taylor of the Stanford Linear Accelerator Center. In the late 1960s, the three men executed a famous series of experiments on the scattering of electrons by protons, deuterons, and heavier nuclei. These investigations gave the first clear evidence for a charged, pointlike substructure—quarks—inside these massive particles. Their citation reads, in part: "The results of these high quality experiments still stand and have been supported and extended to higher energies and momentum transfers by later experiments with electrons, muons, and neutrinos."

**Andrew R. Hutson**, PhD '54, died of lung cancer on December 20, 1988 at age 62. He joined Bell Laboratories in Murray Hill, N.J. after graduating from MIT, and remained there until he retired in 1986. He was noted for his classic work in the fundamental understanding of the piezoelectric coupling of electrons, and was head of the Semiconductor and Chemical Physics Depart-



R.D. Maurer

ment from 1961-75, at which time he pursued further research in his field. He was a Fellow of the American Physical Society, an avid sailor, and had skied down Tuckerman's Ravine in the White Mountains as recently as last spring.

## X CHEMICAL ENGINEERING

From Korea, **Tae-Sup Lee**, ScD '66, writes that for the first six years after graduating from MIT, he was a senior engineer at Shell Chemical Co. in Woodbury, N.J., and the next six he was president of the Daewoo Engineering Co., the Pungshan Textile Co., and the Korea Steel Chemical Co. in Seoul. From 1978 to the present he has been a member of the Korean National Assembly (three terms), and has also served as minister of political affairs (1983-85) and minister of science & technology (1986-87) in the Korean government. He is also president of MAAK, the MIT Alumni Association of Korea. . . . **Behzad Jazayeri**, SM '77, reports that he recently joined Fluor Daniel in Irvine, Calif., as a senior process engineer responsible for providing technical support to clients on design and/or scale-up of fluidized-bed chemical reactor systems. "The weather here is absolutely fantastic and the folks are great. I am however, still a little confused about wearing tee shirts in the middle of December!" he says. . . . The Chevron Corp. has given MIT a grant of \$350,000 for a permanently endowed fellowship in chemical engineering. It will be known as the **George M. Keller-Chevron Graduate Fellowship** in honor of the recently retired chairman and CEO of Chevron, who received an SB from MIT in 1948.

Last fall, **Norman E. Cooke**, ScD '56, received the 1988 CSChE Award in Industrial Practice sponsored by ESSO Petroleum Canada. The award is given annually to a Canadian individual or group who has made a distinguished contribution in the application of chemical engineering or industrial chemistry to the industrial sphere. Cooke was principal chemical engineer in C-I-L's engineering department, and later became chief process engineer for the SNC Group. He is now consulting privately and has been an auxiliary professor at McGill University for 25 years. Last year he introduced ASPEN, the Advanced System for Process Engineering, a state-of-the-art process simulation computer program developed at MIT. . . . Since 1979, **Howard Grekel**, SM '47, has been the president of HG Consulting Associates, Inc., consulting in profit improvement programs in the petroleum industry. His firm's management system (EVOP for Profit) has "increased annual profits for over 200 operating teams by more than \$100 million per year in oil and gas production, natural gas processing, gas pipeline and LPG terminal, and refining operations." . . . Last October **Steve Wilson**, SM '75, moved with his family from Lawrence, Kan. to Scotch Plains, N.J. He is now the operations manager at the TRW fasteners plant in Mountainside, N.J., and says "it is a great area and opportunity."

**Courtland K. White**, SM '40, died on October 11, 1988 of a heart attack in Wilmington, Del. He had retired as director of European operations for Hercules, Inc., after 36 years with the company.

## XI URBAN STUDIES AND PLANNING

**Edward H. Kaplan**, PhD '84, sends word that he is assistant professor of operations research and

public management at Yale, where he is using mathematical models to study the effectiveness of policies for halting the AIDS epidemic. Last summer he performed in the Carmel Folk Dance Festival in Israel. . . . **Charles A. Kubat**, MCP '77, has been named a principal in the firm of RTKL Associates, Inc. . . . **Gail L. Monahan**, MCP '82, is now a vice-president of Boston Financial Asset Management/Investor Services, a division of The Boston Financial Group, Inc. She joined the group in 1988 after serving as director of program development with the Executive Office of Communities and Development of the Commonwealth of Massachusetts.

## XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

**Francis B. Whiting**, PhD '51, is president of Whiting Mining Services International, Ltd., a mining consulting engineering firm; he is also president of four junior mining companies, of Marmot Enterprises, Ltd. (a real estate development company), and of Braymont Utilities Ltd., a public utility water supply company. . . . **Harold J. Noyes**, PhD '78, is chief geologist and business development manager for Doyon Ltd., North America's largest private landowner. One of his major responsibilities is to develop funding for mineral and timber resource development on the company's extensive land holdings in Alaska. His search for investors has taken him throughout the business communities in North America, Europe, and Japan.

The establishment of a major new international award for achievement in engineering and technology was announced recently in Washington by **Robert White**, ScD '50, president of the National Academy of Engineering. Endowed by the Charles Stark Draper Laboratory, the prize recognizes engineering and technology achievements "contributing to the advancement of human welfare and freedom." The first recipient, to be announced in October, will be selected by a committee appointed by the NAE and chaired by Robert C. Seamans, Jr., ScD '51 (XVI), senior lecture at MIT. . . . **Will Perrie**, PhD '80, and **Truc-Chi Huynh**, PhD '87 (III), were married in July 1987 and now reside in Halifax, Nova Scotia. Will is working at the Bedford Institute of Oceanography, and his wife is on maternity leave from the Atlantic Research Laboratory of the National Research Council of Canada, following the birth of their daughter. . . . **Leonard W. Weis**, SM '47, reports that he became associate professor of geology & geography emeritus in the University of Wisconsin Center System last June. "Am spokesperson and a docent for the Hearsthouse in Appleton," he writes. "It is the first home in the world lighted by electricity from a central hydroelectric station using the Edison System. The lights went on on September 30, 1882."

## XIII OCEAN ENGINEERING

The Davidson Medal for outstanding scientific accomplishment in ship research has been presented to MIT Professor **John Nicholas Newman**, ScD '60, by the Society of Naval Architects and Marine Engineers. Newman was cited for contributing "to almost every aspect of the hydrodynamics of ships and ocean platforms over the last 30 years."

**Capt. David B. Flanagan**, NE '62, founded a firm in January 1988 called Bamboo Fencer. The National Gallery of Art in Washington, D.C., has 132 feet of his fence along the I.M. Pei wall for the "Daimgo" show completed in October. . . . **Walter S. Szczypinski, Jr.**, NE '66, has been vice-president of Techmatics, Inc., in Arlington, Va., since 1984. It is an engineering firm listed in *Inc.* magazine's top 500 businesses for 1987-88.



## XIV ECONOMICS

**Richard K. Lyons**, PhD '87, is currently teaching international business in the Graduate School of Business at Columbia University. . . . **Pedro Aspe**, PhD '78, is the new finance minister in the administration of President Carlos Salinas of Mexico. His first assignment was to begin renegotiating Mexico's \$104 billion foreign debt to reduce the net transfer of resources outside Mexico to allow the economy to return to sustained growth, according to the *Wall Street Journal*. . . . The American Association of Lutherans has announced the appointment of **James W. Hanson**, PhD '52, to a one-year term on the Financial Products Committee of their board of directors. The AAL, based in Appleton, Wisc., is the nation's largest fraternal benefit society in terms of assets and ordinary life insurance in force. . . . MIT Professor **Robert M. Solow** has been appointed chairman of the General Motors Science Advisory Committee. He succeeds Thomas Everhart, Caltech's president, who was recently elected to GM's board of directors.

The Alumni Association has been informed of the death of **Richard W. Bloomingdale**, '42, on September 23, 1988 in Tucson, Ariz.; and of **Leon F. Graves**, SM '46, on September 8, 1988, in Houston, Tex. No further information is available.

## XV MANAGEMENT

**Michele De Nevers**, SM '81, is working at the World Bank as a senior economist in the country risk analysis division. . . . **David Labson**, SM '63, has launched a new medical journal, *Contemporary Internal Medicine*, which is targeted at all specialties within internal medicine. . . . **Geoffrey R. Brooks**, SM '79, is completing a PhD in strategic management at the University of Oregon.

**Sven A. Wehrwein**, SM '80, writes that he is still happily working in corporate finance for Drexel Burnham in New York City. . . . As director of product management for computer peripheral technology at Phoenix Technologies in Boston, **William J. Hilliard**, SM '84, is responsible for their project to clone the LaserWriter. . . . **Jeremy Cohen**, SM '88, is working at the IBM Knowledge-Based Systems headquarters and got married last November to Penney Bigel in Brooklyn, New York. . . . **Suellen Fausel**, SM '86, is with the engineering staff of GM's Flint Automotive Division. Her responsibilities include assembly-plant implementation of major future vehicle programs.

**Bruce W. Perlstein**, SM '81, is an economist with Arthur D. Little, Inc., working as a consultant to law firms and other clients on regulatory, financial, and legal questions. His wife, MJ, is an assistant professor at Boston University Medical School, and president of Helping Hands (training monkeys as aids to quadriplegics). They have a five-year-old daughter. . . . "Joined Kidder Peabody two months before the crash," writes **Mahesh K. Kotecha**, SM '74, last fall, "and the day of the crash was my boss' last day. In three months I was promoted to his job; now ten months later we face another year-end on Wall Street. Hope I have less excitement next year!"

**Mark S. Plovnick**, PhD '75, has been named dean of the University of the Pacific School of Business and Public Administration in Stockton, Calif. He was previously associate dean of the graduate School of Management at Clark University in Worcester, Mass. . . . Last October, **Gail M. Cook Johnson**, PhD '78, and two partners started their own management consulting firm called REACON Management, Inc. "Spouse, kids, and business all doing well," she reports. . . .

**Peter C. Lamb**, SM '76, is now the partner in charge of Andersen Consulting's Industrial Products Practice for the Pacific Northwest. They are currently designing all the systems for a new Boeing factory. He and his wife Jane have three

young sons. . . . **Scott P. Mason**, SM '72, a specialist in capital markets, has been promoted to full professor with tenure at the Harvard Business School. He conducts research in the areas of financial markets and securities pricing.

**Terence Burnham**, SM '88, is the founder and CEO of Progenics Pharmaceuticals, Inc., a start-up biotech company focusing on drugs to treat cancer and AIDS. . . . **Scott Armstrong**, PhD '68, was a visiting professor of marketing at IDEA in Buenos Aires in July/August 1988. . . . **Frank H. Mason III**, SM '65, was recently appointed executive vice-president and CFO of U.S. Leasing International, a wholly owned subsidiary of Ford Motor Co. based in San Francisco. It manages \$4 billion of leased assets, including business systems, auto fleets, electronics test equipment, and aircraft. Prior to his new position he was finance director of Ford's Financial Services Group. . . .

"Two important events happened in 1988 for Theresa and me," writes **Gary S. Hom**, SM '81. "First and foremost, Theresa gave birth to our son James J. last year. Secondly, after five years of gut renovation on our 1855 brownstone in Brooklyn, we finally received a certificate of occupancy from the NYC's Building Dept. I certainly learned a lot about construction management and bureaucracy management as I fought through the labyrinth of offices and officers of the Building Dept. . . . **James F. Reda**, SM '83, and his wife Susan had a baby girl, Jennifer Beryl, in August. . . . **Darryl K. Mikami**, SM '86, and his wife Corinne had a baby boy, Kyle Benjamin, last July.

**Michael A. deMarco**, SM '68, is currently developing and managing special projects for Citicorp's corporate strategy. . . . **Richard A. Derbes**, SM '71, is now managing director of Morgan Stanley & Co., the securities unit of Morgan Stanley Group, Inc. . . . Along with being a charter member of Ohio Scanning Network, finance chair of Ohio Alliance for the Environment, and on the board of the Charter Committee of Greater Cincinnati, **Paul R. Freshwater**, SM '68 also finds time to be a manager of issues analysis at Procter & Gamble in Cincinnati. . . . **Marie E. Regas**, SM '83, has recently taken a new assignment with Electronic Data Systems as a consultant in business systems. She was planning an April wedding, as well. . . . **Leland P. Fisher**, SM '82, and his wife adopted their second son, Bill, two springs ago. Leland has started a new job as product manager at Mercury Computer Systems in Lowell, and says "a big hello to the AMPs of '82." . . . **Marcia L. Wasserman**, SM '75, writes that "We are living happily in Piedmont, Calif., with our three wonderful children. I am a vice-president with World Savings & Loan Association, one of the best in the industry. My husband **Andy**, SM '75, is CFO for Paramount Export Co., a major exporter of fresh produce. Yes, Sloan marriages do succeed!"

**Marvin Campen**, SM '48, sends word of his marriage to Cynthia Brady in April 1988. They are living in a 172-year-old historical registered house. . . . **Melford E. Monsees**, '58 reports that "it is indeed a pleasure to be an active Educational Counselor and to interview the students who desire to study at MIT. It is especially exciting since I retired from the University of Missouri."

The Alumni Association was notified of the death on April 4, 1988, of **Lewis N. Miller**. He attended MIT after graduating from the Virginia Military Institute in 1932, and before receiving a master's degree from Harvard Business School in 1935. Miller was retired vice-chairman and treasurer of Miller Manufacturing Co., Inc., a millwork and lumber company in Richmond, Va. He had also served as chairman of S.D.G. Inc., a sash, door, and glass company; and vice-chairman of Atlantic Rural Exposition, Inc., which operates the State Fairgrounds.

### Sloan Fellows

**R. Michael Ross**, SM '81, is currently with International Paper Co. as general manager of their Container Division-West. . . . From **Martha A.**

**Margowsky**, SM '78: "I have served as president and CEO of the Griffin Agency, an advertising agency subsidiary of H.F. Ahmanson, for the past two years, after having immersed myself in marketing and strategy for several firms since leaving Sloan. Am also chairperson of the Caltech/MIT Enterprise Forum in Pasadena. I married Jonathan Curtis in 1987." . . . **Robert L. Rhodes**, SM '54, is now retired after 41 years with Northwest Airlines and one year as a consultant with its sister pilot training company.

**Edward C. Gustely**, SM '63, writes that his consulting work for the Division of Ratepayer Advocates, California Public Utilities Commission, was completed last September. "I provided written original and rebuttal testimony on quality assurance issues developed during construction of the Diablo Canyon Nuclear Power Plant by Pacific Gas & Electric Co. (PG&E). One day prior to the start of public hearings (at which I was to give oral testimony), PG&E and the CPUC settled all issues to the benefit of electric ratepayers. At issue was \$4.4 billion in costs which the CPUC asserted were the result of mismanagement of the 15-year construction programs. With the settlement, I decided to retire, again, and enjoy the California wine country and travel."

Title changes: **Tom H. Barrett**, SM '69, is now CEO as well as president of Goodyear Tire & Rubber Co. . . . **Kendrick B. Melrose**, SM '65, is still chairman and CEO of the Toro Co. in Minneapolis, but is no longer president. . . . **Carroll M. Martenson**, SM '54, has stepped down as CEO of Esterline Corp. in Darien, Conn., but remains as chairman. . . . **David S. Gould**, SM '64, retired as executive vice-president of Caterpillar, Inc., in April. . . . And at Syska & Hennessy, Inc., **John F. Hennessy III**, SM '88, has become chairman of the board of directors and chairman of the executive committee, succeeding his father, who died suddenly in January at age 60. **Eldon C. Hanes**, SM '57, has been named interim executive officer of Electronic Systems Associates, a Syska & Hennessy affiliate, which specializes in designing and implementing voice and data telecommunications, building automation, and security systems. . . . **Allan M. Friedman**, SM '75, has been appointed CEO and president of BFM Energy Products, a subsidiary of BFM Aerospace Corp. He was formerly director of quality assurance.

**Vinod Sood**, SM '64, died suddenly at his home in Vancouver on November 19, 1988, at age 53. He was chairman of the board and CEO of Finning Ltd. Sood was named Marketing Executive of the Year by the Sales and Marketing Executives of Vancouver, and had recently received the Corporate Leadership Award from MIT.

### Senior Executives

"In November 1987, I formed a steel-producing company, J & L Structural, Inc., in Aliquippa, Penn.," writes **Howell A. Breedlove**, '76, "and now serve as president, CEO, and principal shareholder of the company." . . . **Kirtland C. Gardner**, '79, is now president of Hunter Environmental Services, Inc. in Canton, Ohio. He was formerly senior vice-president of Corning Glass Works. . . . The Alumni Association has been notified of the death of **John O. Howell**, '67, of Nashville on July 16, 1988. No further information is available.

## XVI AERONAUTICS AND ASTRONAUTICS

**Arye R. Ephrath**, PhD '75, has been re-elected president of the IEEE Systems, Man, and Cybernetics Society. He is district manager of Software Technology and Systems at Bell Communications Research (Bellcore) in New Jersey. . . . Rear Admiral **Thomas C. Betterton**, EAA '66, is assistant commander of Space Technology at the Space & Naval Warfare Systems Command in Washington, D.C. . . . From California, **Anthony P. Hays**, SM



## Peru on the Brink?

The Peruvian economy and the political system it supports, for which so many were optimistic less than four years ago when Alan Garcia was elected president, is now in disarray. A major economic crisis is almost inevitable, says MIT economist Rudiger Dornbusch, and will lead to a radicalized government far harder for the United States to tolerate than Nicaragua's.

Dornbusch blames mismanagement of its economy for the hapless nation's present plight. In an effort to stimulate the economy, Garcia tried to transfer wealth to the country's poorest people—a policy that backfired because it was inflationary. The same policy also led to national budget deficits—and thus still more inflation.

Now, says Dornbusch, the country's only routes to economic health are drastic tax increases and reduced real wages, improved prices for its exports, or major foreign assistance—all unlikely scenarios.

If it comes, political disintegration in Peru would be a serious blow to U.S. interests. The country's United Left is committed to "pervasive socialization," he says; and there is also an extreme-left minority (the "Shining Path") "whose vision is nothing short of civil war along radical lines."—John Mattill □

'71, writes: "I've been working in advanced design at Lockheed Aeronautical Systems Co. in Burbank for the past 11 years. Last fall I also started teaching aircraft design at Northrop University in Los Angeles. MIT Professor Emeritus Elmer E. Larrabee, SM '48, is also teaching there; he teaches during the day and I in the evening, so our paths have not yet crossed. . . . Stan Rosen, SM '70, is the director of long-range planning in the U.S. Air Force Systems Command Space Division.

The establishment of a major new international award for achievement in engineering and technology was announced recently in Washington by Robert White, ScD '50 (XIX), president of the National Academy of Engineering. Endowed by the Charles Stark Draper Laboratory, the prize recognizes engineering and technology achievements "contributing to the advancement of human welfare and freedom." The first recipient, to be announced in October, will be selected by a committee appointed by the NAE and chaired by Robert C. Seamans, Jr., ScD '51, senior lecture at MIT. . . . Clayton Thomas Crowe, SM '57, professor of mechanical engineering at Washington State University in Pullman, has been named a Fellow of the American Society of Mechanical Engineers. . . . Woodrow Whitlow, Jr., PhD '79, senior research scientist in NASA's Structural Dynamics Division, has been selected the 1989 Black Engineer of the Year for Outstanding Achievement in Government. He is an internationally-known researcher in computational unsteady fluid dynamics. NASA describes his personal research as "highly original, involving the development of theoretical and computational methods for predicting air forces on flight vehi-

cles. Whitlow was the first black American to receive a doctoral degree in Course XVI. Last spring he helped establish an Institute for Minorities for youth interested in science and engineering careers. The eight-week program allows 6th, 7th, and 8th graders to attend a Virginia university on Saturdays for computer instruction and laboratory experiments in science and engineering disciplines.

The Alumni Association has recently been notified of the death of John B. Rickey, SM '50, on November 17, 1984. No further information was available.

## XVII POLITICAL SCIENCE

Deborah A. Stone, PhD '76, writes that she recently published her third book, *Policy Paradox and Political Reason*, and "will gladly autograph copies for any DUSP, TPP, or Poli Sci students who 'field tested' it in my courses." . . . Thomas A. Bryant, PhD '82, is currently wearing six hats: president of Brystra Consultants (management research); chairman, president, and CEO of Professional Electronic Services, Inc.; president and CEO of Taycor Management Corp. (venture capital); chairman of the Saskatchewan Shad Valley Program; chairman-elect of the Society for Manufacturing Engineers for South Saskatchewan; and chairman of the Regine Chamber of Commerce Task Force on Vocational Education.

## XVIII MATHEMATICS

Chung-wu Ho, PhD '70, has been appointed chairman of the Department of Mathematics and Statistics at Southern Illinois University in Edwardsville. He has received two teaching excellence awards and a research scholar award from SIU in the past and is currently an honorary professor of the Hefei Educational Institute in China. . . . Mark J. Ablowitz, PhD '71, will be leaving Clarkson University to accept a position as director of a new program in applied mathematics at the University of Colorado in Boulder. . . . Marianne Maguire Kerwin, SM '57, is an assistant professor of mathematics at Union County College in Cranford, N.J. . . . In July, Richard M. Soland, PhD '64, will become chairman of the Department of Operations Research at George Washington University for a period of at least two years. . . . John A. Nohel, PhD '53, writes: "I continue to divide my duties between research in nonlinear analysis and applied math, teaching, and administration of the Center for the Mathematical Sciences at the University of Wisconsin in Madison (formerly the Mathematics Research Center). My friends and classmates who know her will be saddened to learn of the death of my beloved wife Vera after a long illness in May, 1988."

Robert H. Scanlan, PhD '43, professor of civil engineering at Johns Hopkins University, has won the American Society of Civil Engineers' 1988 J. James R. Croes Medal for his contributions to engineering science. His work has led him to develop basic theories of aeroelasticity of long-span bridges. . . . Richard H. Battin, PhD '51, a significant contributor in the technology of space flight navigation at Draper Laboratory, was recently presented the 1989 Von Karman Lecture in Astronautics by the American Institute of Aeronautics and Astronautics. He is also an adjunct professor in Course XVI at MIT. . . . Hilliard Roderick, SM '46, is one of three editors of *Acid Rain and Friendly Neighbors: The Policy Dispute Between Canada and the United States* (Duke University Press, 1989, \$45). According to the publisher, the book "argues that development of national policies to control acid rain must precede a successful international agreement. Alternatives to formal negotiations for alleviating acid rain damage are also examined."

The Alumni Association has received word of the death of Marvin B. Sled, PhD '54, on October 30, 1988. No further information is available.

## XXI HUMANITIES

MIT Associate Professor Edward Baron Turk has written a new book entitled *Child of Paradise: Marcel Carne and the Golden Age of French Cinema* (Harvard University Press, 1989, \$37.50). According to the publisher, "Marcel Carne symbolizes the period, approximately 1930-1945, when French cinema recaptured the creative vitality and prestige it had relinquished almost completely to the American film industry. . . . This portrait of Carne [is] the portrait of an age, a great age in the history of French cinema, albeit a tragic age in the history of France."



N.R. Ortiz

## XXII NUCLEAR ENGINEERING

The Sasson brothers send word: from Joseph, SM '85: "I have been on assignment in San Francisco for almost a year (March '88 to January '89) working on database application for an interactive geophysical workstation. And Eric, SM '87, writes: "I am now a business engineer for Air Products in the marketing department—I develop new applications and I sell old ones—with a friendly team. MIT and Boston seem so far away. My younger brother is joining MIT in January: welcome in the temple!" . . . Sandia National Laboratories has announced the appointment of Nestor R. Ortiz, ScD '72, to the newly created position of environment, safety, and health director. The new directorate is aimed at bringing a laboratory-wide approach to environment, health, and safety. Ortiz was formerly manager of the Reactor Systems Safety Department.

## TPP TECHNOLOGY AND POLICY PROGRAM

Lissa A. Martinez, SM '80, has been chairing the Panel on Disposal of Shipboard Wastes for SNAME and volunteered to be Program Chair for the Society of Hispanic Professional Engineers' Second Annual Eastern Technical and Career Conference in Washington, D.C., which a group of MIT students attended. Lissa also found time to take a three-week residential field course in analysis of marine pollution at the Bermuda Biological Station. . . . Miren Salsamendi, SM '79, is currently a manager in venture development for Arco Chemical Co. in Pennsylvania. . . . Tony Marra, SM '88, has been employed at the Space Systems Division of Booz Allen & Hamilton in Bethesda, Md. since May. Most of his office's activities are related to providing support to NASA Headquarters Space Station Office.

Seth Tuler, SM '87, is currently looking into PhD programs at Clark and Carnegie Mellon Universities, but in the meantime combines consulting work in London with travel in Italy and West Africa. . . . Julian Villalba, SM '81, remains with the IESA, a graduate school of management in Caracas, and is also doing some consulting in management and public policy in Venezuela and other Latin American countries.—Richard de Neufville, '60, chairman, Room E40-353, MIT, Cambridge, Mass. 02139





# CLASS NOTES

## 16

Had a nice note from **Dick Knowland** of Clearwater, Fla., in which he wrote that he continues to enjoy the memories of being a member of the Class of 1916 and his one year as a research assistant at MIT. He sends his best wishes to his classmates. . . . Had a note and Christmas card from Frances (Mrs. **Paul**) **Duff**. She is in relatively good health and is carrying on the regular visits to her many children throughout the country. She now has 11 great grandchildren.

We regret to report the passing of two of our classmates. **Berthoud C. Boulton** on August 23, 1988, and **Lauriston E. Knowlton** on December 19, 1988. May they rest in peace. . . . Kindly write to **Bob O'Brien**, Acting Secretary, 25 Keith Rd., Pocasset, MA 02559

## 17

**Alvah E. Moody's** passing was reported by his nephew, Robert L. Moody, '34, and by Henry C. Taintor, '21, the only other MIT alumnus ever hired by Natural Gas Pipeline Co. Alvah died November 27, 1988, at the age of 94.

After graduating from MIT he saw action with the army coast artillery corps in Europe. From 1922 until the outbreak of World War II he worked on various construction projects and as a sales engineer. As Lt. Colonel he commanded an anti-aircraft battalion during the war. He went to work for Federal Pipeline in 1947 from which he retired in 1959, returning to his home state of Colorado. He was active in the Presbyterian Church and in Rotary Club, where he also served as an officer.

Alvah's older brother, Harry, '07, passed away in 1963. Alvah's wife died two years ago. He leaves a son and two daughters.—**Don Severance**, Acting Secretary, 39 Hampshire Rd., Wellesley, MA 02181

## 18

At this late date I am happy to report to you the following two interesting notes from **Giles Hulseman** and **Herb Polleys** in response to my annual Christmas greetings.

Giles, of 9045 Ute Rd., Cascade, Colo., answered: "Alright, Max, for what it may be worth to others. . . . Too much snow shovelling at 90 in the cold made me weak in the legs and have no faith in the doctors—felt they actually hastened the deaths of my two wonderful wives. [This] followed a year of several bad falls weakening me to the point of expecting death the first two months of this year. Swelling legs and feet brought me to the doctors and a cardiologist implanted a pacemaker immediately for the 'complete heart block' and put me on a daily diuretic for the 'congestive heart failure.' To get more fresh air, have an apartment in the new Congregate Care facility called 'The Fountains' at Tucson, Ariz., for most of the year. Get a good walk every day—no

dull moments—would you believe it? Life is at its best again, by God's grace. We owe you no end of thanks for all your work in our interests over these many years."

Herb Polleys, of 285 Central Ave., New Haven, Conn., is "now 94 and finally retired. Jack Wood and I (Sigma Alpha Epsilon) had the first sail boat at the Tute! We had sailed together in the Providence, R.I., area since high school. It was the beginning of international competition and he taught the MIT President to sail. Now an international college sport. We were at #484 Beacon St. House together."—**Max Seltzer**, Secretary, 865 Central Ave., Needham, MA 02192; **Leonard I. Levine**, Assistant Secretary, 519 Washington St., Brookline, MA 02146

## 19

### 70th Reunion

We are pleased to report that we received a friendly letter from our classmate **Aubrey P. Ames** of San Francisco. Aubrey is in his early nineties and can not attend our upcoming reunion. We shall miss him at our table.

We also received a letter from the devoted sister of **Russell S. Palmer** reporting his death on December 13, 1988. We thank Mrs. Charles N. Borden for keeping us informed.

The Alumni Office sent us a note from **Francis A. Weiskittel** confirming his plan to attend our class reunion in June. So, on to Cambridge!—**W.O. Langille**, Secretary, P.O. Box 114, Gladstone, NJ 07934

## 21

The fall issue of the MIT *Spectrum* has an article about **Sam Lunden** entitled "The Frozen Music of Samuel Lunden." When Sam was a high school art student in Pasadena, he had lettered a beautiful sign which read, "Architecture is Frozen Music." No matter how the idea occurred, Sam has been making architectural music for 70 years. Sam still hangs out his shingle as a consulting architect and the results of his work are in various places in and around Los Angeles. He runs a weekly lecture series and is honorary chairman of MIT's campaign for the future in Los Angeles. Among his many gifts he numbers a scholarship fund established in honor of past president James R. Killian.

(*Spectrum* is a magazine published in conjunction with the capital fund drive. Classmates who would like to see the *Spectrum* article on Sam should call the Office of Communications, Resource Development, 617/253-3835.)

**Cac Clark** had an 89th birthday on February 12. I phoned him and he tells us he is busy with the class agent job that used to be handled by **Ed Farrand**. He and Maxine are planning to go out to Oregon by train sometime this spring to visit their daughter, Ellie.

**Helen St. Laurent** is back home in Manchester, Conn., after being hospitalized for a broken hip.

**John C. Mahoney** of Westfield, N.J., died on February 24, 1988. Our condolences are extended

to his family.—**Sumner Hayward**, Secretary, Well-spring House E64, Washington Ave. Ext., Albany, NY 12203; **Samuel Lunden** Assistant Secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

## 22

According to my records, which are reasonably up to date, the class of 1922 as of last December numbered 166, about 14 percent of the original 1,200. There are 129 of us living east of the Mississippi, 25 to the west, and 12 in foreign countries. The heavy hitters are Massachusetts with 32, Florida 22, California and New York 11, and New Jersey and Pennsylvania with 10. The foreign distribution is extensive—two in Argentina and one each in Canada, England, France, Norway, Switzerland, South Africa, Haiti, Peru, and Chile.

**Everett M. Strong**, 88, died September 23, 1988, at Winthrop, Maine. He was a retired professor of electrical engineering, having taught at Cornell from 1924 until retirement. He was a native of Yarmouth, Maine, and a graduate of North Yarmouth Academy. In 1952-53, he was national president of the Illuminating Engineering Society from which he received honorary awards in 1966 and 1967. A boating enthusiast, he was a member of the U.S. Coast Guard Auxiliary, honorary member of the U.S. Power Squadron, and a member of the Ithaca (N.Y.) Yacht Club. He is survived by his wife, Ella (Sheffield) Strong, two sons, and a daughter.

**Raymond F. Mann**, 87, died September 27, 1988. He had been retired for many years from the Hooper Chemical Co. of Niagara Falls, N.Y. He is survived by his wife, Myrtle. No further details are available.

**Charles E. Breitbeil**, 87, died January 15, 1988, at Louisville, Ky. After leaving MIT without a degree, he became an attorney, practicing in Louisville. A note from his nephew, Robert J. Breitbeil, reports that his uncle was a retired lawyer and civil engineer: retired lawyer from Frank Haddad and Associates; retired engineer from Army Corps of Engineers.

**Newton B. Schott** died December 4, 1988, in Montclair, N.J. He attended MIT only briefly but then went on to law, becoming a partner in the New York firm of Swiger, Kelly, Harragan, and Schott. He is survived by a son.

**Charles B. Schureman**, 90, died September 1, 1988, at his home in Green Valley, Ill. He was a self employed consulting engineer. No further details are available. Our condolences are extended to the families of the above deceased.—**Yardley Chittick**, Secretary, Rte. 1, Box 390, Ossipee, NH 03864

## 23

To some of our Florida classmates, you may consider returning to New England for at least a portion of the winter to get warm. As I write this, the temperature is in the sixties with no snow in Connecticut and very little for this winter. It is



possible I might eat crow in the next two months.

Your secretary is relieved to report but one death at this time. **Frank J. Salus** died February 2, 1988. He was born in Russia in 1900, prepared for MIT at Rindge Technical School, and received his degree in electrical engineering. He joined Stone and Webster Engineering Corp. after graduation, specializing in hydroelectric station design. Frank was a member of Temple Beth Shalom, Cambridge, Mass., and of B'nai B'rith Lodge. With his wife, he traveled extensively, visiting much of Europe and the Orient. He is survived by his wife, Etta, and two sons, Alan and Richard.

The death of **Bernard Flynn**, reported in the last *Review*, was indeed a shocker, coming only a few weeks following our 65th reunion, which he attended. He seemed full of spirit at that time, coming across the country from California.

Now, classmates, this report is a short one, because you have not given me anything to report. Please write me about what you are doing that would be of interest to us.—**Fred Almquist**, Secretary-Treasurer, 63 Wells Farm Dr., Wethersfield, CT 06109

## 24 65th Reunion

**Adalberto "Al" Roig**, writes from Humacao, Puerto Rico, "I have to express my sad feelings about the death of **Russ Ambach** and the unexpected death of **Rock Hereford**." Al reports that he has made reservations to attend the reunion in June. He also sends a copy of a letter he recently wrote to **Etiennette** and **Laf Quirin**, from which we quote: "You're back from Wellesley at your retirement home in Delray Beach, and I am glad to hear that you feel very happy and comfortable at this place which you say is like a country club. I have not been too well since last April. Because of various reasons, I have not been able to make any cruises after I took the cruise on the *QE2* last January, but in spite of my recent problems I am still looking forward to our class reunion in Boston." Al is still recovering from a dislocated shoulder caused by a fall last December.

Class president **Don Moore**, 20 E. Main St., Apt. 25, Los Gatos, CA 95032 sent the above information and says he has been looking for a volunteer from the class to take the class secretary position. The replies so far have been negative. He is trying to "pinch hit" in the meantime and says, "it would be a real shame to find no class of '24 notes in future issues of the *Review*."—ed.

## 25

It is with sorrow that the passing of three classmates must be reported. **Phillip S. Glasson** died in Marlborough, N.H., on November 17, 1988. Phil joined the Brown Co. in Berlin, N.H., after graduation. Although hired as a chemist during the Depression he became a technical librarian in Brown's research department and he continued in that work until he retired in 1964.

**Frederick D. Shaw** of Cape Elizabeth, Maine, died at a local nursing home on November 4, 1988 after a long illness. Although a member of our class he had transferred to Brown University. During World War II he served as a commander in the U.S. Navy. After the war he was vice-president and general manager of Bettinger Corp. of Waltham, Mass., and later became vice-president of the Walker and Pratt Manufacturing Co. of Watertown, Mass. He was a former president of the New England Foundryman's Association and had served as a trustee of the Watertown Savings Bank. Fred is survived by two daughters.

**Alva B. Morgan** died at his home in Darien, Conn., on May 31, 1988.—**F. Leroy (Doc) Foster**, Secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650



*Doc Edgerton receives a crystal globe of the earth from the National Geographic Society and these words of praise: "Among those rare mortals who open new worlds for humankind to view, few have enjoyed more success than Dr. Harold E. Edgerton and his celebrated stroboscopic light. By freezing on film those rapid movements that elude the eye, he has illuminated a universe of motion that we could once only imagine or see as a blur of speed. By pioneering the high-speed stroboscopic flash, he has helped vanquish darkness as a barrier to photography. And by vanquishing darkness he has opened our eyes to the fascinating realm beneath the sea."*

## Illuminating Sunken Ships and the Wingbeat of Birds

The crownlike corona of a splash of milk, an apple shattered by a bullet, the stop-frame sequence of a perfectly executed dive, a bird frozen in flight . . . these familiar illuminated instants are but a few of the well-loved stroboscopic photographs of Institute Professor Harold "Doc" Edgerton, '27.

Doc Edgerton's contribution to the field of photography was honored last November at the celebration of the 100th anniversary of the National Geographic Society. He was one of 15 people chosen by the Society to receive their Centennial Award. These "men and women who have devoted their lives to expanding knowledge of the earth and its inhabitants" reflect the Society's commitment to research, exploration, and learning.

In the award statement, Professor Edgerton was cited "for his contribution to the technical advancement of photography through his development of the stroboscopic flash and underwater camera systems. His flash devices froze the flight of hummingbirds and illuminated creatures of the ocean depths; his side-scan sonar led to the discovery of the sunken Civil War ironclad *Monitor* and the shattered cabin of the *Challenger* space shuttle."

Doc's collaboration with the National Geographic began in 1947 with his first article showing the magic of hummingbird flight. Then, sponsored by the Society in the mid-1950s, "Papa Flash"—as he was affectionately called by the French crew of Cousteau's *Calypso*—developed a camera system that did not require flash bulbs and rescued the research vessel's photographer from laceration by exploding light bulbs underwater.

While celebrating 100 years of expanding horizons of knowledge about our world, Society President Gilbert Grosvenor used the occasion to ask, "Can we save this fragile earth?" To back up his plea for "more knowledge", the individuals honored each received a \$10,000 award, to be donated to the research field or organization of the recipient's choice. Doc chose the MIT Museum to receive his monetary award.

Among the other 15 luminaries of natural exploration to receive the award were: Jacques-Yves Cousteau; Mary and Richard Leakey; Sir Edmund Hillary; Senator John Glenn; Bradford and Barbara Washburn; Jane Goodall; and Robert D. Ballard, who found the sunken RMS *Titanic* in 1965.—*Susanne Fairclough* □



**Peter L. Bellarchi** of Portland, Ore., wants to be remembered to classmates and at 86 years of age, he is still very active. Those of you who are electrical engineers have known of his graduate work for a Ph.D. in electrical engineering and for his work for Westinghouse and Bonneville Power Administration. He worked on the first lightening made by man and from this developed the techniques on how to protect yourself and equipment from high voltage with two patents for equipment. He became a fellow of the IEEE in 1940 and has lectured all over the world in four languages. Much of his work resulted in long distance transmission of electrical power. . . . **Evart J. Horne** of Worcester, Mass., died October 2, 1988. Evart was a civil engineer at the Worcester Water Bureau. He lost his wife, Gertrude, 10 years ago, but leaves a daughter, three grandchildren and one grandson. . . . **Louis R. Taylor** of Bethlehem, Pa., writes that when he was here for Dr. Killian's Memorial, he was "impressed by the MIT campus and renewed friendships there." He and Ruth are looking forward to their 60th wedding anniversary in June.—**Donald S. Cunningham**, Secretary, 27 Lowell St., Braintree, MA

**Russell H. Brown** died October 27, 1988, in Falmouth, Mass., after a lengthy illness. An architect, he was associated with several Boston architectural firms including Hutchins and French. He made a survey of the Beacon Hill area providing plans and diagrams to show the various zoning of residential and business areas. In World War II, he served in the naval reserve with the Seabees. His letter of April 16, 1945, from the Marianas Islands said he was acting editor of the *Buzzin' Briefs*, the battalion paper.

Russ returned to Falmouth and was a member of the planning board. He was a member of the Massachusetts State Association of Architects and the Boston Architectural Club, of which he was on their board of directors and secretary for 10 years. He was an active member of various fraternal and veterans groups and received the highest honorary degree in the York Rite Freemasonry.

**Albert Walton** died on June 2, 1988, in Newark, Del., at the age of 90. He was one of our oldest classmates, having received a degree in electrical engineering from the University of Delaware in 1919, then an S.B. in electrical communication from MIT in 1927. His widow, Sylvia, writes, "In the depths of the Great Depression when unemployment was about 98 percent, he became a founding member of The Federation of Architects, Engineers, Chemists, and Technicians (FAECT). They worked to organize white collar workers and professionals into new local unions and were responsible for the pressure that resulted in the projects of FERA, CWA, WPA, etc."

He worked in various aircraft engineering firms during World War II. He retired from engineering at a young age in 1948 to open Sandy Brae Nursery on farm land he inherited from his father. He specialized in collecting and growing rare plants. We send our sympathy to his widow, Sylvia, and family.—**Joseph C. Burley**, Secretary, No. River Rd., Epping, NH 03042; **Lawrence B. Grew**, Assistant Secretary, 21 Yowaga Ave., Branford, CT

We have a good letter from **Martin Brillhart** who confesses it to be his first message ever for Class Notes. Martin (known to some as "Van") began his student career as a member of the Class of '27. After three years he ran out of funds so took a year off for work and to rebuild his finances. Upon return to MIT he became a member of our class; this to our good fortune. Martin reports that both he and his wife are in good health. He

enjoys walking and does about three miles every day. . . . **Sark Sarkisian**, whose wife Roxie had only recently died, sent us a note but failed to comment upon himself. However, he does write in a firm hand and positive manner so we can trust he is in good health. . . . **Hy Weinberg** sent his thanks and appreciation especially to the Boston-based reunion committee. He says "The five-year reunions with the opportunities to join classmates of earlier years have been memorable events in our lives." . . . **Katherine Hazen** says she appreciates receiving late greeting cards because they come after the holiday pressure is off. Being one of only 27 Tech co-eds among several thousand men, Katherine says she knew very few classmates. Yet, as a student, she did meet and marry her husband, Harold, '24, and thus began a wonderful life at MIT. . . . A pleasant note from Kay and **Ben Draper** tells us they are well except that Kay is somewhat troubled with arthritis.

**Dick Hildick** wrote and told of some telephone talks he had enjoyed with **Jack Rouleau** and **Nap LaCroix** in which they recalled old student day experiences and some of the things they have done since. . . . Then a letter from **Nap** referred to the same telephone discussions but he expanded somewhat on the subject matter. In the first half of 1925 **Nap**, **Dick**, **Jack Rouleau**, **Frank Sweeney** and one other chap shared living quarters on Hemingway St. in Boston. Apparently friction developed with the landlord (something about the making of homestyle wine in a closet) and this led to the fragmentation of that living group. **Nap** had other roommates, later and at various times, including **Joe Jamison** and **Bob Proctor**. At present **Nap's** recovery from his aneurysm of two years ago has been slow but his courage remains good. He is hoping to visit family members in Leominster, Mass., and possibly MIT friends in the Cambridge area.

We were saddened by a letter from **Paul Ruch** telling us that his wife, Dorothy, had died after sixteen months in an extended care facility. His letter was followed shortly by one from **George Chatfield** who had also heard from Paul. As students they had a close association and were roommates at one time. Paul was general manager of *The Tech* and George was editor. On behalf of the Class we have expressed our sympathy to Paul and his family.

**George Palo** who has the triple office of '28 vice-president, treasurer and class agent, has written to inform us that gifts to MIT from '28 class members, for the period of July through December of 1988, total exactly the same in number as for the corresponding period of 1987. His comment: "At least, our class is consistent." Gifts made prior to June 30 of this year will still count in the current Fund Year.

With deep regret we must report that **Charles E. Worthen** died on February 25, 1989. Charlie's wife, Velma, gave us the information by telephone from their home in California and said that he had been ill for a long time. Charlie graduated in electrical engineering and had his professional career with General Radio Co., now GenRad, Inc. He was an outstandingly loyal member of '28 and our class agent for many years. On behalf of the Class we expressed our sympathy to Velma and her family.—**Walter J. Smith**, Secretary, 37 Dix St., Winchester, MA 01890; **Ernest R. Knight**, Assistant Secretary, Box 98, Raymond, ME 04071

## 60th Reunion

One of the distinguished members of the class, **Brig. Gen. James E. Howarth, Jr.**, USMC (ret.), of Arlington, Va., has sent me a note. "On November 20, 1988, I travelled to Tarawa Atoll to commemorate the invasion 45 years ago, and to participate in the dedication of a monument to the Second Marine Division. This time was much different than November 20, 1943. It is now called the Republic of Kiribati, and the Japanese are

back with a fish processing plant instead of guns."

In December, **Richard Piez** moved into a plush retirement home known as the Peninsula Regent, One Baldwin Ave., Apt. 518, San Mateo, CA 94401. He also sold his lifetime home in January. You can imagine the task he had disposing of unwanted items which have accumulated in a lifetime. "I had kind of a busy period, and was unable to send holiday greetings, so stay well and have a nice year in 1989!" Richard is planning to attend our 60th reunion.

**Hyman J. Fine** of Norfolk, Va., writes, "I am working three days a week on water resources projects. I deliver 'Meals-On-Wheels' to shut-ins, and I am a 'Friendly Visitor.' I also play tennis, and attend lectures and seminars on world affairs. In my spare time, I just take leaves."

**Amasa G. (Mace) Smith** of Birmingham, Ala., retired vice-president, Southern Area Operations, Chicago Bridge and Iron Co., was honored for his lifetime of outstanding community service. A past Rotary Club president, Mace has also served as president of Associated Services (now the Business Council), the Boy Scout Council, and as chairman of the Red Cross. In 1960, Birmingham named him as 'Man of the Year.' Mace has also served tirelessly with the United Way as president, as general campaign chairman in 1959, and as a member of its executive, planning, and budget committees. He was also a leader in the United Way's highly successful Food Bank Program. He is one of only five living life members of our United Way. Mace is a deserving recipient of our Community Service Umbrella.

**Robert K. Miller** of Allentown, Pa., who lost his wife last September, has a new address: 543 Walnut St., Allentown, PA 18101. . . . **Neil C. Ross** of Santa Cruz, Calif., writes, "After the death of my wife Alice in 1976, I remarried in 1977 and I am enjoying a very happy second marriage. My wife Helen and I have 12 great grandchildren between us. We are enjoying my second retirement."

I regret to announce the deaths of the following members of our class: **Fred N. Ricks** of Mobile, Ala., in March, 1988; **Seymour A. Baum** of Jupiter, Fla., on August 5, 1988; **Mrs. Mabel C. Merritt** of Dedham, Mass., on October 10, 1988; **Ira H. Abbott** of Newport News, Va., on November 3, 1988; and **Norman L. McClintock** of Gastonbury, Ct., on December 23, 1988.—**Karnig S. Dinjian**, Secretary, P.O. Box 83, Arlington, MA

**Al Luery**, on a trip north from his Florida home last August, stopped in to see Marge and **Hal Spaans** at their new retirement home in Willow Street, Pa. According to Hal, they had a fine time talking over their World War II experiences. The Spaans also keep in touch with **Hank Halberg**. . . . As previously reported, **Morris Shaffer** retired in 1985 as professor emeritus at L.S.U. School of Medicine and Tulane Medical School. He and his wife have friends and former associates in many foreign countries and find these contacts helpful when they travel abroad. . . . The **Tul Houstons** took a Royal Viking cruise to Leningrad from Copenhagen last July and found Leningrad very disappointing. . . . In a recent reminiscence **Willard (Bill) Selden** notes that he started at MIT with the Class of '27, changed courses, stayed out a year to earn enough money (less than \$2,000 at that time) to continue, and finished in Course XV-2 with our class.

Apart from the above items the news is downbeat. We have at hand notices concerning the deaths of four more of our classmates. **Ben Yoffe's** death on February 24, 1988, was reported by his brother-in-law **Hyman Rosenberg** who also briefly attended MIT. The only information I have about Ben is derived from the Alumni Registers, from which it appears that for much of his career he was supervisor of electrical engineering at the Boston Naval Shipyard in Charlestown, Ma. He is



survived by his wife Esther. . . . By coincidence **Richard Whitehead** and **G. Franklin Temple** both died on August 25, 1988. Dick, before his retirement in 1969, was director of planning for Santa Barbara County, Calif., for 23 years. His job involved implementing zoning regulations, reporting population and economic statistics, preparing forecasts for the Board of Supervisors and master plans for the development of the county. After retiring he studied in depth the early history of Santa Barbara. He completed a master plan for the acquisition and development of the 200-year-old Santa Barbara Royal Presidio and helped supervise its reconstruction. He is survived by his wife Marianne, three children, six grandchildren, and two great-grandchildren. . . . At the time of his retirement **Franklin Temple** worked for Foote Mineral Co. in Exton, Pa. After retirement he worked as outside representative at mortgage settlements for a savings and loan bank. About a year ago I received a note from his wife Louise bringing the sad tidings that, like a growing number of our classmates, he had contracted Alzheimer's disease. . . . **David Jacobus** who died on November 9, 1988, was a doctoral candidate during our time at MIT. He received an undergraduate degree from Stevens Institute in 1921 and worked for much of his career at Brookhaven National Laboratory where as Senior Mechanical Engineer he was involved in such projects as the Graphite Research Reactor, the Cosmotron and the Alternating Gradient Synchrotron. He is survived by his wife Elinor, two sons and five grandchildren.—**Gordon K. Lister**, Secretary, 294-B Heritage Village, Southbury, CT 06488

## 31

**Kenneth Edward Wischmeyer** writes, "I have enjoyed a full life with a loving wife, three wonderful children and their spouses, and seven grandchildren—two with college degrees, three in college, and two in high school. My wife and I, after graduating from MIT, went to Europe on the Washington University Steedman Traveling Fellowship. We traveled on a motorcycle and sidecar from N. Africa to Sweden, all on \$3,100. We have traveled all over the world and now are content to enjoy our soon-to-be 80 years. I have only the best memories of MIT, my fellow students, and my excellent professors." . . . **Francis Dicken Weeks** says he was married in 1933 and now has three children, seven grandchildren, and two great-grandchildren. He has been active in community affairs and is a member of the Chicago Academy of Science, IEEE, the Society of Colonial Wars, and the Sons of the American Revolution. During World War II, he attained the rank of commander in the U.S. Naval Reserve. Appointed archivist for the University Club of Chicago in 1976, he researched, wrote, and published monographs regarding architecture and interior decor. His hobbies include color photography and foreign travel. He has visited more than 100 countries, presented more than 140 travel talks, and has sold more than 4,000 slides from his "Winnisimmet Collection" to art museums and colleges.—**Edwin S. Worden**, Secretary, P. O. Box 1241, Mt. Dora, FL 32757; **John Swanton**, Assistant Secretary, 27 George St., Newton, MA 02158

## 32

Rose and **Tom Weston** sent me a Christmas and New Year card which included a form letter detailing all their activities for 1988. Highlights include a trip to the Caribbean to celebrate their 40th anniversary, the annual National Pilgrim Fellowship in Wisconsin, religious sponsored conferences in Vermont and New Hampshire, and high school reunions. Tom was chairman of our mini-reunion. He planned an Inland Waterways trip on the S.S. *Charleston* for April 1989. However, the American Cruise Lines filed for bankruptcy and the trip was cancelled. All monies were



Rose and Tom Weston, '32

returned. Maybe something else will be attempted in 1990.

**Arthur Marshall** is probably our most indefatigable travelling activist. Recently, he took in the Seoul Olympics and spent seven days in Israel. He speaks often to Springfield organizations, where he gives his impressions and insights. Arthur wants to extend to his classmates his personal and friendly greetings through these classnotes.

**F. Rolf Morral** and his son, John E. (PhD '68), have co-authored an article which was published in a new international journal called *Promecanica*. Rolf has already had over 200 articles published on research, development, technical service, education, history, and metallurgical subjects. Most are in English, but he has also published in Spanish, German, and Catalan. His professional career spans 55 years.

**Billie and John Strickler** celebrated their 50th anniversary on March 31, 1988. How about sending us pictures? . . . **Carl H. Wahlstrom** writes us about his financial struggles to get through MIT. Losing his father when he was two, and with no family help, he had to borrow heavily to make it. I hope and trust that he considers the struggle worthwhile. . . . **Frederick Hoyle** says that he is feeling fine. Cleaning up his two acres of land keeps him pretty busy. His hobby is photography. . . . **Thomas Anderson** is now in retirement. He has survived one heart failure and is wondering about the next.

**Frank Cook**, Ph.D. sends us more information concerning his demographic projects. He has collected valuable evidence that will help third world countries with population growth-rate problems. The main answer is educating high school girls and allowing them to enter the work force. I quote him further as follows. "My measures of over 30 variables in over 70 countries show many other revealing facts. For instance, education grew almost 1:1 with urbanization. But education, and not urbanization, explain the growth-rate drop. My theory is that education, especially of women entering their fertile years, opens young minds to the opportunities of lifestyles other than constant childbearing. Mothers who limit their family size will save resources needed to send their children to school. When third world growth-rates are reduced by about half, they seem to enter a different socio-economic demographic regime, one more like that of developed countries. I hope that those interested in this very important problem contact responsible members of the incoming administration and Congress."

No obituaries in this class report. Hooray!—**Melvin Castleman**, Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

## 33

Your fearless leader **Dick Fossett** and Frau are cruising along the Antarctic peninsula hoping to produce photographic history. He is also fearless enough to arrange a meeting of class officers this fall—I believe the first of its kind in history. More on this later. . . . **Dick Robinson**, 161 Boston Post

Rd., Weston, MA 02191 (617) 894-5809; recalled our 50th at Chatham Bars. His old Chevrolet convertible finally rusted out, but he's not rusting out, sort of wearing out, he reports. . . . **Wilber Huston (Bill)**, 1265 Lauren Lane, Lady Lake, Florida 32659 (301) 858-0774, wrote to Beau last fall. His condition is still poor. **Beaumont H. Whitten's** address is Sharon Towers, Charlotte, NC 28210.

**Leonard Julien's** Christmas letter just missed last class notes; phone: (617) 734-3266. He enjoyed our 55th in Cambridge and Chatham Bars. His wife Doris finally retired from Brookline Town Hall. Daughter Sheryl writes on food and recently visited Italy for two weeks to report on food and wine there. . . . We printed **Walt Skees** phone number in Barcelona incorrectly—it is direct dial 011-34-3-3298543. . . . **Jack Andrews** happily renewed old ties with **Norm Harris**, discovering they lived 35 miles apart. If any other classmates are in the area, give Andrews a ring: (609) 896-1714.

**Emerson Norris** died December 8, 1988. He had worked for Revere Copper and Brass, Sylvania Electric, and Channing Corp. Mrs. Norris resides at 47 Oliver St., East Hiram, Maine. . . . Mrs. **Eloise L. Gardner** died November 9, 1988. She studied in England before graduating in architecture, and was a nurse's aide during World War II. Her activities included local politics, hunting, painting and golf.—**William Klee**, Secretary, Box 7725, Hilton Head Island, SC 29938

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## 55th Reunion

There's a nice little group of Alumni Fund notes to get the column off the ground this month. From our concrete expert, **Jerome Raphael**: "Have been elected a director of the U.S. Commission on Large Dams. Wrote parts of two books on the technology of large dams—both have been published. Ruth and I cruised to Japan by way of Alaska and the Aleutians last summer. Enjoyed what we could see of it through the clouds and the drizzle. Next summer to Copenhagen and New Zealand." . . . A brief note from **Gil Lorenz** explains why we missed him at the Basin Harbors' mini-reunion. "I had to miss the 54th reunion because of by-pass surgery. Hope to see everyone at the 55th." If Gil's surgery is as successful as mine was eight years ago, he'll have no problem. . . . From **Melvin Souza**: "In addition to my orange grove (navels, if you please) I am breeding and showing sport horses for dressage and jumping. I am crossing my thoroughbred mare on 'European Warmblood.' This year I have the champion two-year-old filly at the Osierteau Breeder's Futurity at San Juan Bautista, Calif. (I hope I have all the names right—Mel's writing is quite small and compact)."

**Max Winer** writes, "Sole owner of the corporation Research Engineers Inc., 106 North St., Watertown, MA 02160. It is the marketing agent for a world-wide organization selling desalination equipment for producing drinking water. Selling in the New England area." . . . A note from **Raymond P. Holland, Jr.** says, "For the past several years I have been studying wind turbine design for improved conversion of wind power to electrical power, exploring cost reduction, efficiency increase, and achieving greatly improved durability and simplicity. Last spring my wife Astrid and I and our daughters Nancy and Linda enjoyed touring Britain, successfully tracing family roots." . . . **George C. Hatch** writes, "My wife Clara and I are both in good health and are reasonably active. Part of last year and early this one (1987 and 1988) I had successful radiation treatment for cancer. Got back to speed again by September when we went on a five-week trip to India and Thailand. We plan to go to China next year." News of recoveries like that are great to receive; having taken a trip to India several years ago it's wonderful that George's recovery was rapid enough for him to undertake a trip like that.

On the darker side, I also have several losses to



report. For **Charles Hellmers IV** of Hampstead, Md., I can only tell you that he died April 19, 1988. **Ralph Marotta's** widow, Rose, advised that, while he died in St. Louis in June 1988 from metastatic cancer of the bone, he had been suffering from Alzheimer's disease for ten years.

**John A. Elder Jr.** had started at MIT and went on to get his BS from Boston University. Although he came from Lynn, he spent most of his working life in the Plainfield, N.J., area. He was with Merck for 15 years, then Union Carbide for 20 years, retiring in 1979. Mr. Elder is survived by his wife Gertrude, a son, and daughter.

**George M. Woodman, Jr.** died on November 3, 1988, in a Rockport, Maine, hospital. He had graduated from Bowdoin College in 1931 and came to MIT for post-graduate work in naval architecture. During his time at Quincy Shipyard he had worked on the liner *S.S. America*. In World War II he served in U.S. Navy service commands and then went to Portsmouth Naval Shipyard from which he retired in 1973. He had wintered for some years on Big Pine Key, Fla., where he could follow his interest in yachting. Mr. Woodman is survived by his widow Audrey and a large family: three sons, a daughter, two brothers, a sister, and eight grandchildren.

For all of us I would offer condolences to those remaining, especially Mrs. Marotta whose ten years of dealing with Alzheimer's must have been a truly trying time.—**Robert M. Franklin**, Secretary, P.O. Box 1147, Brewster, MA 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

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**Willard F. Bixby** writes from Novelty, Ohio, that he is doing consulting work in chemical engineering for a number of clients primarily in the fields of environmental quality and corrosion control.

... **Thonet C. Dauphine** writes from Acton, Mass., that he enjoyed attending the Convocation for the Centennial of Chemical Engineering Education at MIT last October. ... **Arthur H. Cohen** sent the following from Lexington, Mass.: "Still active in architecture; developed, own and manage an Industrial Park in Woburn. Active in Temple Shalom, Newton; designed Chapel, worked with artists on stained glass windows of sanctuary and many parts of temple. Lecture on architecture to older Sunday-school pupils. Associated with firm that did architectural work throughout Massachusetts. Got an honorable mention for Stop & Shop market built in 1946 on Memorial Drive."

The Distinguished Scientist Lecture Series of 1988-89 sponsored by the Bard College Center and the National Patent Development Corp. opened its program with Dr. **Walter H. Stockmayer's** lecture "Dynamics of Chain Molecules" last October. On November 18th Stocky arrived in San Diego with Sylvia to accept the ACS Award in polymer chemistry. I had the pleasure of having Sunday dinner with them. Many years ago the three of us used to sing with the community choruses of Lexington and Wayland. ... **Edward J. "Ned" Collins** writes from Easton, Mass., that his wife Florence died on December 4th after a long illness. Ned had been taking care of her for the last four years. Prior to that he was a regular member of my Saturday golf foursome. He says his mind is set on moving to a warmer climate. ... **Bernie Nelson** dropped me a note to say that **Henry F. King's** wife, Elsie, died in late January 1989. I am sending Hank sympathy and condolences from his classmates.

I am sorry to report to you the deaths of three more of our classmates. **John C. Russell** died October 30, 1988, in Minneapolis after a lengthy illness. Before retiring in 1975 he was president of Singmaster & Breyer of New York City. In the '40s, '50s and '60s he worked in the Amazon, Zambia, Italy and Czechoslovakia developing new metallurgical techniques for producing cobalt, copper and uranium for Third World countries.

During the depression he worked at gold and copper mines in the Southwest and Alaska in jobs ranging from assay manager to "shotgun Man" for the truck delivering gold bullion from the mines to the bank. His wife died in 1975. He is survived by three daughters, a son, 15 grandchildren and six great-grandchildren.

**Elmer J. Roth** died November 11, 1988, at Concord, N.H., Hospital after a long illness. He was a consulting engineer until World War II when he served in the U.S. Navy as a Lieutenant Commander. After his discharge he worked for Ernst & Ernst in Boston. He served as controller for the Whitin Machine Works and Stop & Shop before moving to Connecticut to become vice-president of Fafnir Bearing Co. and Loctite Corp. He was called out of retirement to become vice-president of New England College, Henniker, N.H., and dean of student affairs at Nasson College, Springvale, Maine. He is survived by his wife Vera, two sons, three daughters, two stepdaughters, four grandchildren, eight step-grandchildren and a brother.

**William H. Brockett** of Juniper Hill, Del., died in mid-December 1988 of complications of Alzheimer's disease. Bill was a marketing manager in organic chemicals with the DuPont Co. for 40 years. At MIT he was a member of the Phi Sigma Kappa fraternity. He is survived by his wife, Eunice, two sons, four daughters and two grandchildren. I am sending condolences to the families of these three men.

This last letter comes from **Bud Pflanz** in Sierra Vista, Ariz., and is just the change of pace these notes need. "Rather than list the accomplishments of my children or grandchild (I have only one, aged 1 year) or give a glowing account of my travels, or list my accomplishments in the retired world, I thought I would take off on a few observations. On your trip to California via auto, did you take note of the messages on the various bumper-stickers? Now that the snow-bunnies have descended on this section of Arizona I have taken note of their bumper-stickers that have tickled my fancy. I ARE A COLLEGE STUDENT ... OF ALL THE THINGS I LOST I MISS MY MIND THE MOST ... NO. THIS IS NOT DAD-DY'S CAR IT'S MOMMIES ... DRINK: DON'T DRIVE YOU MAY SPILL THE BEER ... MAFIA STAFF CAR DONNA BUMP. Just to name a few.

"Had a rather exciting emergency helicopter ride last June when the Arizona Dept. of Public Safety evacuated me from the local army hospital to Tucson University Hospital. I had a severe prostate operation, went into shock, kidneys failed, lungs filled with water, etc. Air evacuation was necessary as land ambulance would take too long. Needless to say, I recovered and am back to having two martinis a day, without olives as they are fattening. My Urologist has a beautiful sense of humor. He says he is jealous of a hunter or fisherman who can have their largest catches mounted and hung on the wall. He removed the second largest prostate gland on record and the hospital won't let him hang it in his office. I'm tired of hearing 'Have a nice day'. My retort is 'Thanks but I have other plans!'"

One last note: I heard from **Chet Bond** the other day, he lives only 50 miles away in Sun City. He, Ham Dow and I will be playing a round of golf together at Temecula, which is half between us, in the near future. Your letters and notes are eagerly anticipated.—**Allan Q. Mowatt**, Secretary, 715 N. Broadway, Apt. 257, Escondido, CA 92025

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Harking back to my meetings with classmates near Los Angeles last October, President **Alice Kimball** used the occasion of the Pasadena brunch to take soundings in our upcoming 55th reunion. (It's not too early—signing up an inn must be done as much as two years in advance.) **Henry Lippitt** liked the retrospection which **Pat Patterson** engineered at the 50th, and all agreed

that **Bob Gillette**, **Stan Johnson**, **Laddie Reday** and **Harry Essley** had prompted our own recollections of way-back-when. These Notes have related several suggestions that have come up in my visits, and they seem to meet with favor. So perhaps we can find some more, with equally good, succinct speakers for the 55th. Also suggested was some event in Cambridge just for 1936, such as a special class tour and lunch at the MIT museum on the day of POPS. Then we might spend a few days on the Cape as has been our custom. What do you think? Please write soon to Alice at Box 31, West Hartland, CT 06091.

Year-end holiday greetings from classmates helped to brighten our days, which were far away from our own families this year. **Betsy** and **Harry Essley** mentioned sailing off Maine near Pemaquid Point in September; **Mary Lou** and **Gordon Thomas** mailed their card from Ste. Agathe, Quebec, where they were with family for fall and early winter, and finally got enough snow in January for cross-country skiing. ... From **Lucy** and **Charlie Holman**, we learn that the former's sewing for an expected grandchild and the latter enjoying his latest skeet title—World Veteran Champion of Champions, won in October. ... **Wally Mathesius** sent a card from Beaver, Pa. ... **Vicki** and **Clax Monro** were in the Fiji Islands, New Zealand, and Australia in December; and spent Christmas with their daughter Victoria and husband at his parents' home in the mountains between Sydney and Canberra. ... **Ruth** and **Henry Lippitt** did their usual wide-range traveling; two months in Ruth's Swiss homeland, for which she won travel tickets; and a side trip to Italy, with opera and ballet at the Roman amphitheater in Verona.

Continuing with your responses to the MIT Directory questionnaire, the Alumni Fund, etc.: **Mac Nyhen** continues with the International Trade Administration of the Department of Commerce at Washington; **Bob Caldwell**, also Course VI, has retired as CEO from California Products Corp., the largest regional point and coatings manufacturer in the Northeast. **Bob Woodcock**, Course XIII, continues to enjoy golf, fishing, and boating at Vero Beach, Fla., in winter and Little Compton, R.I., summers; **Henry Wilsey**, Course VI-C, has served for 40 to 60 years with organizations in Montclair, N.J.: dramatic club, engineering society, and Boy Scouts of America, which honored him with its Silver Beaver Award.

**Win Scott**, Course II, retired from Boeing in 1985, has continued since 1987 his aircraft interests as a volunteer at Seattle's Museum of Flight. He reports that this is a world class exhibition, combining the original Boeing factory building with a magnificent steel and glass structure adjoining. He recommends visiting it when near Seattle, and I hope to do just that next year on a northwestern tour of classmates. ... **Ariel Thomas**, Course I, retired board chairman of Metcalf and Eddy of New York, traveled to Alaska last June. Major construction of their summer place in Coventry, R.I., was finished last year, and he and wife Avis were working on shelves, closets, gardens, stone walls—enough to keep them "busy for years." They had the pleasure of one granddaughter's graduation from Wellesley last May and another beginning sophomore year at Miami of Ohio.

**George Trimble**, Course XVI, retired as CEO of Bunker Ramo Corp. in 1980 after a career in aircraft and spacecraft with Martin Marietta, NASA, and the Visiting Committee For Aero and Astronautics at MIT. George and wife Janet made Carefree, Ariz., their permanent residence in 1980, where he has undertaken design and construction of a tiny V-8 engine. He says the "purpose is to keep him out of the kitchen, off the street and develop 20 horsepower." Carefree is, in a wide-west sense, "just down the road a piece" from Santa Fe (some 500 miles). So I'll be stopping in my camper to see this engine, George. ... **Charlie Saffer** continued on in chemistry at the Institute to get his MS and PhD, then won a fellowship for research at Oxford 1939-40, and was



awarded an honorary MA by Oxford in 1973. Nevertheless, he considers his U.S. Navy service in World War II a significant highpoint in his life, notwithstanding his successful career in research and development management. He is Lieutenant Commander USNR, retired for physical disability in 1946.

**Bob Newman**, Course X, who joined us in junior year from Case, was assistant professor of management at New York University in the 1960s and 70s and then manager of planning services for General Electric. He has a large collection of ancient coins, with emphasis on those featuring architecture, clothing and hairstyles. Also, he has some 150 hours of 8mm sound film and many thousands of slides, recording their travels all over the globe by foot, sailboat, canoe, motor vehicles and trains. . . . **Henry Runkle's** widow Natalie has moved to a smaller apartment at 9104 Fortuna Dr., Mercer Island, WA 98040. At her writing, she anticipated son Fred's marriage December 31 with elan that denies her physical disability. . . . **Henry McGrath's** wife Mildred died last May after years of battle with cancer. This was a few weeks after I visited them in Virginia. She was at the 45th reunion but could not make the 50th. In January Henry was hoping to sell their former home in New Jersey soon. He is still hiking, mountain climbing and swimming with vigor. . . . When we visited **Roman Ortynsky** in Peachtree City, the highway to Atlanta was a maize of construction, and only the day, Sunday, saved us from long traffic delays. Now a note from Ro reports completion: "Since you braved it, our 'information center' thinks that you deserve the enclosed map!" Thank you, Ro and Bernadette.

Classmates in New York, Connecticut and Western Massachusetts (but no one else is excluded), make a note on your calendars for a mini-reunion on the last Saturday in October. Details will follow in subsequent issues.—**Frank L. Phillips**, Secretary, 901 Los Lovatos, Santa Fe, NM 87501; **James F. Patterson**, Assistant Secretary, 170 Broadway, Pleasantville, NY 10570

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We have news of Dr. **Bert Bennison** and family, Box 224, Eastham, MA 02642. Bert's wife Lella writes, "All four children managed to spend a few days here with us and so did several friends. Their visits were the highlights of the year. Lucy helped put in a meadow whose blooms vary with the season. Bert has cleared the view of the pond along with the asparagus patch. He's also planted some raspberries and blueberries but in this colder weather migrated to the basement where he's experimenting with hydroponics. When my lights dim it's a signal he's got the Shoptsmith going. We crossed the bridge once to go to Washington, D.C., to take a four-day genealogical course at the Archives. In September we went on a genealogical safari to Nova Scotia seeking data on Bert's family. We manage to get occasional intellectual 'fixes' in Cambridge and Boston but since daughter Lucy and husband Bryan moved to Pittsburgh last September we've lost our local 'pad.' Bert made a couple of crossings without me as he does occasional consulting on health problems associated with H-G Thermometer manufacturing in New York City. Bert has two alumni clubs quite active in the area and we're involved but of course there's no University of Texas one near. . . . We both are active in Historical Societies. Our most active involvement is with a small Unitarian fellowship (about 24 members) of mostly retired people.

"Our children have all had a good year. They're 'DINCS' still (double income no children). Daughter Alice finished law school last year and this spring began a job she's happy with as policy director (a kind of lobbyist) for the Oregon Hospital Association. Son John's computer software company is always on the verge of something exciting. Lucy left her job as Director of

Education for New England Wildflower Society and is teaching science in a small girl's school. Son Charlie, with a friend, is trying to get a catering service going in Tallahassee where he's a professional cook. . . . Bert and I stay healthy (knock, knock) though we suffer from Sometzimers and on occasion Mostzimers but thank heavens, so far, we haven't had Alzheimers."

**Phil Peters** retired from John Hancock as executive vice-president and director in November 1980. He received the Babson medal for outstanding service to Babson College in May 1988. Phil is Chairman, Babson College Corp.; honorary, vice-president (former president) Greater Boston Chamber of Commerce; and vice-chairman emeritus (former president) World Affairs Council. His sports are skiing, golf and tennis and he plays bridge. Phil writes that they "spend much more time at our Jackson, N.H., retreat, which I love. Will spend five weeks in Florida and expect to see Alice and **William Johns**, Janet and **George DeArment** and Rose and **Bob Thorson**, in March and early April. 1988 has been good to us and our extended family, including Peter's nine grandchildren. Ruth continues to gain strength and vitality following her 1986-1987 operations. Both of us worked on the U.S. Open in June, held at our golf club. August and September saw first trip abroad in three years. Spent three weeks in Scotland touring lovely country and searching Ruth's genealogical roots."—**Lester M. Klashman**, Secretary, 289 Elm St., Apt. 71, Medford, MA 02155

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The mini-reunion is June 9 (evening of Technology Day) at Endicott House. Call me or **Horace Homer** at (508) 564-4374 for details and reservations. There may still be space for lodging, and breakfast as well.

It was only about 12 years ago that **Norm Leventhal** was exhorting us to buy \$2,000 worth of chairs for the renovation of 10-250. Now he and Muriel have endowed a professorial chair in the School of Architecture and Planning, with a focus on "city building" in large-scale urban environments. As co-founder and chairman of the Beacon Companies, Norm has held this subject dear throughout his career, having built many buildings and complexes, both public and private, in the Boston area. We understand this new chair costs slightly more than \$2,000, in fact, many-fold more.

**Jack Chapin's** entry in our reunion book refers to his yard work and his work with Literacy Council. We now learn that his "yard" is actually a 27-acre woodland. A practicing engineer all his life, Jack was for decades an engineering professor at Penn State. Along with the pleasure of following his former university students, Jack has seen the progress of those he helped through the Literacy Council—one of whom got his citizenship through Jack's assistance. Finally, any of you who are "birders" should be in touch with Jack, whose list of identified birds is now up to 60. Darned good!

Speaking of the 50th reunion book, it's not too late to get a copy. Send a \$25 check to **H.H. Homer**, 702 Quaker Rd., North Falmouth, MA 02556. Include news of yourself, which Horace will forward to Don or me. That is how we learned that **Korky Kaulakis** is running a business called Afkay Associates out of the old homestead in Chatham, Mass., presumably dealing with energy-related new ventures. We also learned that **Murray Hayward**, after realizing that the real money was in finance rather than engineering, worked at Lincoln-Mercury for 31 years and now divides his time between Birmingham, Mich., and Naples, Fla. . . . We had to go to the 44 class notes to find out that **Corny Roosevelt** is still hot-air ballooning in France, and sharing baskets with other alumni.

Don reported last fall that **Lou Bruneau's** wife, Sandy, broke her collarbone in August. As of this

writing she's still undergoing physical therapy and watching Lou enjoy golf, having accompanied him to an invitational at John's Island. . . . **Don Severance's** bad knee restricts him to cross-country skiing but gives him extra time to help elderly people with their tax returns. Your assistant secretary is doing the same things but without the bad knee.

Last year I requested in the 1905 notes information on widows and living offspring of the class of '05. Surprisingly, four people wrote with info on eight sons and daughters and one wife. If you have any more info, please let me know.

It's our sad duty to report the death on Christmas Eve of **Tom Griffin** of Ipswich, Mass. He'll be remembered for his active participation in ROTC and Scabbard and Blade. After leaving the Institute he spent his life at the Portsmouth and Charlestown navy yards, retiring in 1975 as a systems analyst. He was also an active ham radio operator for 30 years.—**G. Edwin Hadley**, Assistant Secretary, 50 Spofford Rd., Boxford, MA 01921

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## 50th Reunion

**George Beesley**, co-chairman for our 50th reunion, reports completion of registration and reservations by 53 classmates before February 8. They are: **John Alexander**, **Jim Barton**, **Hans Bebie**, **George Beesley**, **Pete Bernays**, **Bill Brewster**, **Phil Bush**, **Nick Carr**, **Dodie Casselman**, **Wade Caywood**, **Dick Christie**, **Wiley Corl**, **Mark Curgan**, **Art Curtis**, **Lawrie Fabens**, **Don Gleason**, **John Hamilton**, **Mike Herasimchuk**, **Will Jamison**, **Ernie Kaswell**, **Leo Kiley**, **Walt May**, **Charlie Mercer**, **Mort Metzger**, **Dave Morgan**, **Manning Morrill**, **George Morrison**, **Bill Murphy**, **Art Olson**, **Brownie Parker**, **Irv Pescoe**, **Henry Phillips**, **Bob Pratt**, **Bill Pulver**, **Bob Sackheim**, **Bob Saunders**, **Fred Schaller**, **Bob Schmucker**, **Mort Schultz**, **Sam Sensiper**, **Hal Seykota**, **Paul Stanton**, **Gail Swan**, **Morgan Sze**, **Don Timbie**, **Al Velho**, **Bud Venable**, **Dick Walker**, **Ted Welton**, **Bill Widlansky**, **Sears Williams**, **Holden Withington**, **Art Zeldin**.

**Ernie Kaswell**, **Fred Grant**, and **Fred Schaller** accomplished their miracle: they formed, edited, and released to printer our 50th Reunion Book. Delivery to 134 classmates (who paid their class dues) is scheduled for March. The book will contain about 175 biographies and some "then-and-now" photos guaranteed to excite comment.

**Jim Barton**, Chairman of Class of 1939 50th Reunion Gift Committee, reported \$3,699,000 was the total committed as of January 30, 1989. Jim's advice to the committee: "Let's not sit on our Beaver Tails. Let's go for a new record—say 5 million!" So far, 283 (out of 388) classmates have given during the crediting period.

**Morrie Nicholson's** mellow baritone will lead us at Chatham Bars Inn in songfests which may include renditions of old favorites such as **Silver Dollar**, **Michael-Michael**, **I Want a Gal**, **These Bones Shall Rise Again**, **My Bonnie**, **Bell Bottom Trousers**, **Only an Old Beer Bottle**, **Ace in the Hole**, **There's a Hole in the Bottom of the Sea**, and selected parodies. Assistant Holders of the Music Committee Broom include **Aaron White**, **John Alexander**, and **Hal Seykota**.

Distinguished guests to attend major events during '39er reunion will include **David Saxon**, 41, **Paul Gray** and **Professors Edgerton** and **Solow**.

**Manning Morrill's** cheerleading notes and **Mike Herasimchuk's** "Affinity Group Sporadic Newsletter" report continuing good news and superb prospects. **King Cummings** was honored by election to the Board of Trustees of the College of the Atlantic in Maine.

**Pete Bernays** attended the groundbreaking ceremony for a new Chemical Abstracts Building on Ohio State University's campus September 1954. Then 34 years later and after a distinguished career, Dr. Peter M. Bernays retired and attended a reception in his honor in the Battelle



Room of the CAS Building for which he helped break ground. Pete and Marie share other honors with Norma and Morrie Nicholson—all four are members of the select Order of the Arrow, a Boy Scout Service organization.

**Bob Touzalin** and **Aletta** report they slept in 89 different beds last year as their hobbies in pewter, skiing, and canal-boating in England, France and Holland kept them away from their Naples, Fla. home about half of the year.—**Hal Seykota**, Secretary, 1701 Weatherswood Dr., NW, Gig Harbor, WA 09335

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The Class of 1940 Reunion Gift Committee met at the MIT Faculty Club on February 1 and 2 to hear a number of speakers from the Alumni Association, and to set goals. Classmates in attendance were: **James Baird**, class president; **Edgar Bernard**, class treasurer; **Tyler Marcy**, reunion gift committee chairman; **Thomas Creamer**, **John Danforth**, **Richard Dickson**, **Bruce Duffett**, **William Hagenbuch**, **Joseph Jeffers, Jr.**, **Amos Joel, Jr.**, **David Morgenthaler**, **Karl Pfister** and **Edward Wallace**. **Kenneth A. Smith**, '58, associate provost and vice-president for research, spoke on "MIT and Stimulation of Long Range Strategic Options." **Glenn Strehle**, '58, vice-president and treasurer, addressed the group on "Orientation to the Campaign for the future and its relationship to our class work." Life Income Funds at MIT was discussed by **Frank McGrory**, associate director, capital gifts and legal affairs; and **Joe Collins**, managing director, alumni activities, provided hints about how to ask for a gift. A compromise figure of \$4,500,000 was selected as the campaign objective. There has been an excellent start in the form of a \$1,000,000 gift from one classmate. All gifts received between July 1, 1985, and June 30, 1990, will be included. Also included will be all pledges for payments through June 30, 1995. Class member names were divided among the Committee members, and solicitations will begin soon, so expect to hear from someone, and be prepared to do the best you can to help the class to make, or even to exceed, the ambitious goal set for us!

**Louis Michelson** of Newton, Mass., writes that he is retired, and spending his winters skiing at Mount Wachusett, Aspen, Hunter, Stowe, Loon and Cannon. He finds it a great sport.

**Paul W. Witherell** of Raynham, Mass., sent a message to tell us that his wife passed away very suddenly in June, 1988, of cardiac arrest. (Our deepest sympathies, Paul.) Paul had suffered from a stroke in August 1985 and had become increasingly dependent on his wife. He expresses his thanks to classmates and friends, who have been very kind and helpful to him.

Another sad bit of news comes from Commander **Alan M. Thewlis**. He writes, "My wife, Winifred, returns to active life after replacement of two heart valves and repair of a third. My joy over this medical 'miracle' is tempered by approaching death of eldest son from renal cell cancer, for which no successful cure is yet available. I continue active and happy in retirement."

**Lee Hurley Bloom** enclosed a note with a gift to the Alumni Fund. He says, "MIT 1940 was well represented on an exciting alumni travel tour, 'Cultural Russia in Autumn,' November 10 to 20, 1988. In addition to my wife, Mary Lea and myself, Eleanor and **Harry Cottle** and **Joyce and Dick Kendall** were with us. Enjoyed Bolshoi in Moscow, a small motel in Kalinin and wonders of Leningrad, Hermitage, et al."

From Alameda, Calif., **Clement F. Burnap** sends a message that he was retired by Kaiser Engineers in 1982. Since then, he has been doing sales work for several engineering and construction companies. More recently, he has been working with two mining engineering companies on mine ventilation services and geomechanics. With all his activities, he has had no time for travel this year.

**Jack Schaum** of Long Grove, Ill., sent a copy of his Christmas letter, summing up his retirement years. In 1982, Jack took slightly early retirement from his position as publisher-editor of *Modern Casting* magazine, concluding a very rewarding and exciting 26-year career in this capacity. He immediately became immersed in various "non-paying but useful" activities, including president of the local Lions Club, the Friends of the Vernon Area Library, the Northwest Investors Group, and director of the College of Lake County Foundation and the Long Grove Historical Society. In addition to hobbies of gardening and woodworking, he finds time to golf, swim, read, and travel. Jack and his wife have had enjoyable, often exciting adventures in Mexico, Brazil, Iceland, Luxembourg, East and West Germany, Switzerland, Austria, Italy, Greece, Turkey, Kenya, Tanzania, Japan, Taiwan, Hong Kong, Australia, New Zealand, and Tahiti. His four children and his grandchildren are spread around the country, but they have two family reunions a year, as well as many other visits.

By now, you will have received the notice concerning our 50th reunion, and most of you will have sent back positive responses. We hope to see a tremendous turnout of class members just a year from now.—**Richard E. Gladstone**, Secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

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**Milton R. McGuire** writes a note which sets a new class notes record for brevity: "Still enjoying retirement in California." Come on, your classmates are wondering what you are doing Milton, please send a postcard schnurstraks (right away). . . . The Management Education Institute, of Acorn Park, Cambridge, tells us the latest adventures of **D. Reid Weedon, Jr.**, the chairman of the MEI Board of Trustees. MEI was originally organized to provide a practical oriented management education for people who expect to work in developing countries. Reid has been at Arthur D. Little since 1946. He has been responsible for work developing jobs in Puerto Rico by encouraging U.S. companies to locate branches and plants there. Currently Reid has reduced his work at Arthur D. Little to three primary activities, chairing the Board at MEI, a subsidiary, continuing with the South African evaluation program, and chairing the Arthur D. Little Foundation, the company's philanthropic organization. In addition Reid is chairman of MIT's National Campaign Committee, which is charged with raising a billion dollars. He is a life member of the MIT Corporation. Reid is currently chairman of the fund drive for the Manomet Bird Observatory. The list of Reid's involvement in other educational and public service enterprises goes on and shall be continued in a future column.—**Joseph E. Dietgen**, Secretary, Box 790, Cotuit, MA 02635

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Penning (actually word-processing) this from Clearwater mid-February. Hot spell here, temperatures in the mid 80s. Does not interfere with golf. Play just about every afternoon; sometimes we take off Sunday!

Was in Dallas last week and had a good chat with **Ed Vetter**. He had one foot out the door on his way to Cambridge for MIT meetings. Ed is on several visiting committees and does a lot of work setting up sponsored research. He "invented" a Department of Commerce for the State of Texas and is its chairman. . . . **Hazel and Fred Gander** winter in Dunedin and were over for a visit last night. Both are fine. Still have their permanent address in Kennett Square.

Have seen a goodly number of classmates hereabouts. **Ben Skinner** lives in Dunedin. **Dick Andrews**, **Charlie Jelms**, **Morrie Katz**, **Ken Leghorn**, **Bill Rote**, **Jack Altekruse**, and **Phil Sheridan**

either live or "snow-bird" down here. Planning a 1942 mini (or would it be micro) reunion in March.

In the Honors and Awards Department, **Bob Rines**, referred to in the article as "distinguished Boston patents lawyer and MIT patent law professor," received the Beyond War award for his work with the Academy of Applied Science.

**Art Avent** retired after 42 years with the Auchter Co., the last 11 years as its president. Art is still an active member of the Educational Council. He reports that he visited the old MIT Camp at East Machias, Maine, which brought back lots of fond memories.

**Ed Telling** died at Courtland, N.Y. His career included service in World War II. He left the army as a major, was president of Brewer Tichner Corp., with Gunitie Associates, then Shuron Division of Textron, and finally general manager of Thor Metal Products.—**Ken Rosett**, Secretary, 191 Albermarle Rd., White Plains, NY 10605

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We have received further information from the family of **A. Donald Moll**, whose passing was mentioned in the Class Notes several months ago. Don was a native of Tonawanda, N.Y. After working as a metallurgist with the Manhattan Project, he spent thirty years in the steel industry, retiring in 1984. He was sales manager and then president of Minneapolis Steel Castings Co., and finally president of the metals division of Evans Products Co. Don was an active churchman, an avid fly fisherman, and a former mayor of Roseville, Minn. He succumbed to leukemia in April 1988. We join family and friends in mourning his loss.

**Gil Monet** took advantage of the class ring offer that appeared in the notes some time ago. He now has his very own ring and is fully qualified to attend the 50th reunion. . . . A letter from **Sherman Sackheim**, map included, informs us of his new location in the mini-metropolis of East Lake Weir, Fla., somewhere between Leesburg and Ocala. He has exchanged the real estate business for social security and the life of a budding author. His first opus will be a compendium of wit and wisdom, tentatively titled, *The Care and Feeding of Buyers, Sellers, Tenants and Other Wild Animals I Have Known*. He will, no doubt, be pleased to autograph copies for classmates.

During the recent arctic blast in this part of the country, the flame froze in the lantern, and instead of blowing it out, we had to break it off.—**Bob Rorschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

## 44

### 45th Reunion

From Marblehead, Mass., **Daniel Lord** writes that he is in the process of deeding the development rights of 100 acres of mainly woodland to a non-profit organization to protect it from future building. The land will then become part of an environmental complex. The area is in New Hampshire, but less than 30 miles from MIT.

By the time you read these notes we hope you will be in the final stages of your planning for attendance at the 45th reunion. We look forward to greeting you at what promises to be a memorable event.

We have two sad events to report. **Robert Cummings** was killed on October 8, 1988 while hiking in the Himalaya mountains in Nepal. He died while climbing Annapurna with companions with whom he had climbed for years. Annapurna rises to a peak 26,502 feet above sea level. He had climbed mountains all across this country and in Europe, but had never climbed the Himalayas. Bob was a distance runner at MIT and continued his interest in this sport after leaving the Institute. He had run in 25 marathons including the Boston Marathon. We have many fond memories of Bob, especially of his playing of the bagpipes



at our class reunions while garbed in his traditional Scottish uniform. Our deep sympathy goes to his wife, Barbara, and to his children, stepchildren and six grandchildren.

The second sad event to report is the death of **Arthur Peterson**. On January 3, 1989, Pete suffered a fatal heart attack while using his snowblower to clear bits of snow that the plow had left in his driveway. He had had a near fatal heart attack in April 1985 shortly after our 40th reunion but after a month in the hospital had made a wonderful recovery. Pete and Ronnie were looking forward to joining us in Bermuda for a renewal of the good times we all enjoyed with them at the 40th. We extend to Ronnie and her five children and eight grandchildren our deep sympathy.—Co-Secretaries: **Lou Demarkles**, 53 Maugus Hill Rd., Wellesley, MA 02181; **Andrew Corry**, P.O. Box 310, W. Hyannisport, MA 02672

## 45

Yes, a year from now we will be celebrating our 45th reunion. At times, it seems only like yesterday we were scurrying about the Grad House or Rm. 10-250. Although, at this writing, we do not have a reunion chairman, I am certain that **Chris Boland** will have appointed one by now.

Chris and Jean visited with us here in New Castle early last week following their usual week of cross country skiing at Christmas Tree Inn in Jackson—and again per schedule the Bolands had dinner with the **Jim Hourihan's** in Intervale.

Suffice to say we seek your reunion thoughts early on as time's awasting! Chris and I thought that a New Hampshire/Vermont reunion might be a change from the crowded Cape—hiking, golf, tennis, chair-rocking and the like in the crisp cool air of the mountains as compared to our typical two days of rain! Start planning now.

In mid-November, **Harry W. Mergler**, Leonard Case Professor of Electrical Engineering at Case Western Reserve, was elected vice-president of educational activities of the Institute of Electrical and Electronic Engineers Inc. . . . A typo in our Feb./Mar. class notes in regard to **Randall D. Esten Jr.**'s recent death prompted a lengthy letter about Doug from Ed Rosenberg. '47. Doug and Ed were roommates in Bemis, one of the old parallels behind Walker, in 1942. Doug, a diabetic, was prohibited from the service and often felt embarrassed to be a young, healthy-looking, trim six-footer. After a few years with Corning Glass Doug turned to his first love—geography—and spent his entire career working for the U.S.A. Government in cartography. His last work was with NASA preparing maps of the moon.

A few one-liners from our Christmas and Valentine cards. **Mary Trageser** and **Mary Hoaglund** are planning an Elderhostel trip to England, Ireland, and Wales later this year. These two wonderful gals would enjoy hearing from you. Yes, they both continue to be busy with their families. Mary Trageser speaks of her fifth grandchild while Mary Hoaglund continues to bounce about the world visiting friends and family. . . . A lengthy note from **Jerry Paterson** in Texas indicating that the proposed Super Collider to be located in Waxahachie adjoins, in part, his property (and lots of others!). Jerry voices no concerns as the tunnel will be way, way down.

Trudy and **Max Ruhrmund**, who continue to divide their time between Dover, Del., and a farm on the Eastern shore, have married off their youngest daughter. . . . Louise and **Tom McNamara**, still manage a couple of trips each year to exotic spots around the world. . . . We were delighted to hear from Elaine and **Bill Shuman** of Damariscotta, Maine; more importantly to learn that they continue to have a guest mooring in Round Pound. . . . Jan and **Charlie Paterson** were disappointed to learn that our suggested class of '45 golfing trip to Ireland this spring did not fly.

The **Chris Bolands** had two weddings in 1988.

Son Tom and Caryn in Westport, Conn., on April 16; followed by daughter Beth to Michael Emery in Greenwich, Conn., on May 28. As you might expect there was considerable dancing and merriment at both affairs. Tom and Caryn live in Cincinnati while the Emerys have an apartment in suburban Lynn, Mass. . . . **George Bickford** continues to ski—Aspen, Vail and upstate New York. He also made a trip to England in 1988. . . . **Jimmie** and **Tom Stephenson** raved about their trip to Europe which we mentioned in our last Notes. . . . **Carol** and **Nick Mumford** win hands down the '45 grandparent honors—18! Nick continues to spend the bulk of his time working for the Episcopal Diocese in Michigan with four or five trips a year to visit grandchildren spread from coast to coast.

Anne and **Bob Maglathlin's** note was filled with activity—six weeks in Florida, a June week in Colorado where Bob attended the Tri-service Radar Symposium, plus two weeks in October at Prince Edward Island, Anne's homestead. After some 40 years or thereabouts, we understand that Bob is about to be recognized and accepted by PEI-ers! . . . Notes from **Jake Freiburger**, **Pete Hickey** and **Jim Brayton** commenting about the great time we had aboard *Jake's Water Music* last June—so great that we all want a repeat performance. As we write these notes the Braytons are skiing in Switzerland, the Hickeys are rocking in Topsfield, and the Freibergers are undoubtedly enjoying their new home on Man-of-War Key in the Bahamas.

No Christmas card but a great Valentine from Edna and **J.J. Strnad** indicating that son Jeff and Mary Jo Peterson, a former law student of Jeff's were married on December 17. The Strnads were in Chongding, China, in late October when Jeff phoned with his marriage plans.

Have a pleasant summer.—**Clinton H. Springer**, Secretary, Box 288, New Castle, NH 03854

## 46

Hey! The system really works! The Student Financial Office sent a note to Prez **John Gunnarson** about the recipients of the 1988/89 scholarships made possible through our class gift, part of our 1986 40th reunion activity, so well carried out under **Ernie Buckman** (gift committee chairman), **Bob Spoerl** and **Jim Goldstein** (class presidents emeritus), 24 other volunteer classmates, and a number of Alumni Office staff. Kinda makes you feel all warm inside, as if these youngsters might be considered as members of class of '46. . . .

The recipients, and a little of their background and status follow. **Jerome Grula**, from Wilkes Barre, Pa., is a senior double "E" hopefully headed for a Ph.D. Jerome is "into" athletics and physical fitness, working part-time in Tech's Physical Education Department, and during summer break, full time in the Luzerne County Department of Engineers. . . . **John Mandeville**, another senior from Beltsville, Md., is a pre-med major actively working in the field. He works in the Biology Lab and the Chemical Engineering Department, and volunteers in the emergency ward at Mass General. . . . **William Ramstrom**, of Grafton, Mass., is a junior, Course VI, with special interest in meteorology, spending a good deal of time in Tech's Meteorology and Oceanography Center as a computer programmer. In the summer, he works in software development at Data General in Westboro. . . . **Lisa Robinson**, a West Roxbury lass, gets her SB in chemistry this June. She's been active in campus activities: founder of MIT's Alpha Chi Omega sorority chapter, member of Phi Lambda Upsilon, Chemistry's Honor Society, and associate freshman advisor. . . .

**Michael Steir**, of Marysville, Wash., is a political science sophomore. He's working part-time in the Center for International Studies and Film Processing. In his spare time, he's an assistant scoutmaster in Cambridge. Michael is aiming for his master's and a career in the foreign service. . . .

**Eric Monson**, a promising course VI/VIII junior from New Brighton, Minn., hopes to hang in for a PhD in preparation for a career in teaching and research. Eric is an "avid cyclist" and active frat member, working summers at Honeywell in Minneapolis.

Meanwhile, back in the Dark Ages we still have several oldies-but-goodies I haven't mentioned in a long time, if at all. First there's **Morrie Chomitz**, born and raised in Philly and a Penn U. transfer into Course X as a V-12 sophomore. He wasted no time after graduation and his navy release to return home to enter into the chemical industry, including coal tars and asbestos insulation (later found to be carcinogenic) and finally into Jay & Zimmerman (in Philly), where he became senior vice-president of technology, "involving a variety of mostly process related industries" and in charge of CAD and CAE operations. Morrie's a widower since his wife Nancy died of cancer in 1969 after a 19-year marriage, producing three achieving children, two boys and a girl, spread around the Union from Cambridge to Laguna Beach. He enjoys tennis, gourmet dining, and world traveling and has no retirement plans.

And when did I last mention **Jim Craig**, Mr. Everything in our small world and one of my favorite gentle men [sic]? After his navy stint, he married Diane who helped him through an MBA at Harvard. This business acumen coupled with his Course II engineering smarts propelled Jim into large development efforts in the years to come. Seventeen years with the Sonnabends were followed by his own initiatives to develop real estate, including the sizable Lewis & Union Wharves project in Boston Harbor. Beyond this he has put his estimable energies into helping the less fortunate help themselves through non-profit social service activities. The Craigs have two boys and a girl, all grown, plus at least one grandson out in Mill Valley, Calif. I get the impression that he hasn't yet figured out what "retirement" means. We owe you one, Jimmy.

Thought I'd re-mention **Bob Fagot**, an old semi-roomie "out of the fleet." Bob got his letters as an aerologist with the rest of us V-12ers but got interested in psychology, which he studied at LSU near his home in New Orleans. From there he was accepted at Stanford to pursue his field. After one-and-one-half year "glitch" when the navy called him back for weatherman duty, he settled down to get his PhD, which Stanford awarded him in 1956. He majored in measurement theory, psycho-physics, statistics, and math models. He was hired by Oregon U. in Eugene and became professor emeritus in 1968 after teaching and heading his department for 30 years. He married Beverly Fields in 1961 while she was a grad student at O.U. She, too, received her PhD in psychology and also became a professor! She specializes in developmental psychology. They have two sons, both O.U. graduates. Bob expects to teach "part-time" for another couple of years. Glad to hear you like the Northwest, Bob. As an ex-weatherman, it should be interesting. Have you run any marathons lately?

**Joel Feldstein** got his Course II letters a year after us because he fell in a navy service crack. After graduation, he was commissioned and stayed in for active sub duty during the Korean flap and later made captain in 1968. Meanwhile, he got into MacArthur Fuel Oil in Newark, N.J., where he's been the past 11 years or so, making it up to general manager. Barbara, his wife of 32 years, came out of Wellesley to teach high school chemistry and biochemistry and has written a textbook on the subject. They have two grown daughters. One out of Brown, is a reporter; the other, out of Tufts, is an EPA engineer. The Feldsteins live in Livingston, N.J.

If the above seems sketchy and/or out of date, it's partly because the data is out of the "Bio Book" which is at least three years old. I hope y'all will feel free to bring me up to date on your lives, if the spirit moves thee. Have a happy summer.—**Jim Ray**, Secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222



Two long letters this month. Last time we had one—maybe three next time?

**Norm Holland** is Milbauer Professor of English at the University of Florida and is one of the few literary theorists to have received psychoanalytic training. He has published nine books—the most recent being *The Brain of Robert Frost*. Norm writes a fascinating letter about a trip up the Nile from Cairo to Aswan last Fall (600 miles). We'll use his words: "Our ship proceeded in a leisurely way up the center of a ribbon of green between two vast deserts. Scenes like those from a child's illustrated Bible unfolded before us: people wearing gelibayehs (the long gowns that look like mattress covers) and riding camels or mules; date palms (much more delicate than our Florida segoes and royals); partly veiled women carrying pitchers or laundry or even television sets on their heads; the muzzins' call (now amplified and loudspeakered) from mosques lit with green neon; and sand, sand, sand. High moments of the trip were: the sarcophagus of Tutankhamen, 220 kg. of beautifully inlaid gold; the graffiti by a Greek general on the gigantic leg of (a statue of) Rameses II at Abu Simbel announcing the final defeat of the Nubians with the result that in the early sixth century B.C., Egypt turned from Africa toward the Mediterranean; the final hieroglyph—scratched by a fleeing priest as the last temple of Isis was being destroyed by Christians in the 3rd century A.D. That was the end of a writing and civilization that began in 3100 B.C., not to be deciphered until Napoleon and the Rosetta Stone. Curiously, the least interesting sights were the Great Pyramid and the Sphinx just outside Cairo—that was how fascinating the rest was. We came away with our perception of Ancient Egypt utterly changed. We had seen a civilization existing for far longer than our own, with its belief in the supernatural control of the rhythms of fertility, an art and a thought that permanently changed Greek, Roman and Christian culture."

**Jim Prigoff** writes from San Francisco—which "is as close to paradise as one can get." Jim retired in 1984 but hasn't been able to stay retired! Since then he's done some turnaround and crisis management consulting and also is an author, photographer and lecturer—particularly documenting mural art. His last book (he was a co-author) sold 41,000 copies world wide in the first nine months and, one year after publication, was #4 on the London list of best selling art books. Last fall, Jim fulfilled a life-long ambition to see the Himalayas and also trekked 200 miles around Annapurna in Nepal and visited Lhasa and Nepal. Recently he did a lecture/slide show on the trip for the Explorers' Club. Miscellany: Jim is still ranked nationally in both doubles and singles squash (even though he never knew the game existed when he was at MIT). Jim and his wife have four children and ten grandchildren.

Plans for the production of a major new public television series, "Great Projects: Engineering in Society," have been announced by the three organizations participating in the project: The Great Projects Film Co., Inc.; the South Carolina Educational Television Network; and the National Academy of Engineering (NAE). The six part series is expected to be aired in the fall of 1990.

**Jordan Baruch** (president of Jordan Baruch Associates) is on the NAE Film Committee.

**Ben Craig** has been president of B.H. Craig Construction Co. in Florence, Ala., since 1955 and also very active in the community. He was mayor of Florence from 1966-69, on the Business School Advisory Board of Auburn University from 1978-85, president of the Alabama branch of the Associated General Contractors of America in 1974, and is also an Elder in the First Presbyterian Church. He and his wife (the former Ann Bradshaw) have six daughters and six grandchildren.

**Bob Creek** retired as vice-president of Unocal in 1986. He's been president of the local high school Board of Trustees for 19 years. He's also a

director of a school for the handicapped. For recreation he's involved "with the arcane art of dressage with Lipizzaners and other horse breeds." (No, we don't know what it means!).

**Tom Bay** resigned as president of Hytek Microsystems, Los Gatos, Calif., in August 1988.—**Robert E. McBride**, Secretary, 1070 Pilgrim Parkway, Elm Grove, WI 53122

## 48

**George Fountas** began his third career in 1981 formulating specialty coatings for mold release applications. Starting from zero sales and a new operation, George has increased to a facility with 20 employees and 20,000 sq. ft. of space for the business. George's philosophy of understanding his customer's requirements for product function, method of application, inventory requirements (due to the high cost of the materials), and his ability to tailor any of these requirements to meet the customer's needs has enabled his company to grow. They are selling to plastic and metal molding operations throughout the world. Since he didn't have the capital to create his own company, he has built his division within the George Mann Co. which had many years of experience with low margin commodity chemicals like caustic soda. One of George's earlier careers involved tailoring vinyl plastisols to many product applications ranging from automobile air filters to coatings on wire, fabrics, and metals.

**Graham Sterling's** understanding of the good and the not-so-good is tested frequently. In February his granddaughter, Felicity Gwenth Slater, was born. Felicity and her cousin, Arlie Graham Sterling, IV, add to the happiness of Graham and his wife, Judy. In December, Graham and Judy's house burned and they are living in a mobile home that was transported to their property in Norfolk, Mass. No one was injured during the fire and their home is being reconstructed. Graham joined Analog Devices in 1974 when the company was just getting going. He is a vice president and one of his responsibilities is in the area of support that Analog Devices gives to MIT's Industrial Liaison program.

In addition to his company's support of MIT, Graham has personally been a major contributor serving as president of our class from 1978 to 1983. He was also treasurer and has been an active member of the committees that planned the last four reunions. While Graham was president of our class, he spearheaded a successful effort to increase the frequency of obtaining matching corporate gifts when they were available for contributions to MIT.

Graham and Judy's son, Gordon was discovered to have Duchenne Muscular Dystrophy at age 5. Gordon became confined to a wheelchair while in high school, and needed to have a tracheotomy and to learn to live with the continuous help of an electro-mechanical respirator since his senior year at Tufts. Fortunately the Apple computer became available just at the time he became chairboard. Gordon has a natural talent for computer operating systems and applications, so has progressed from that first little Apple to be a respected Digital Signal Processing Engineer.

Gordon now lives independently, with live-in and visiting nurses. He does most of his software design work at home, but he has a van with power systems to compensate for his profound muscular weaknesses, so is able to visit his company office two days per week and to attend meetings in Boston of the Commission on Licensing Respiratory Therapists, to which he was appointed by Governor Dukakis.

**Jim Frevert** was the founder and is past president of the MIT Club of Palm Beach County (1976 to the present). In 1977-81 he also served on the Educational Council in Palm Beach, Fla. He is a financial and estate planner. In January 1988 he visited Antarctica which completed his trips to all seven continents.

**Sonny Monosson** says his favorite hobby is

creating new and unusual businesses. Since 1956 he has started seven companies. In 1988 he started Equipment Remarketing Co., which remarkets high technology equipment for banks and leasing companies. One of the more visible companies is Monosson Technology Enterprises, which produces a newsletter called "The Monosson Report on DEC and IBM." Sonny has provided generous support for our class reunions. He was chairman of our 20th and 25th reunion committees and since then has been the publicity chairman for all the following reunions. He published the yearbooks for the last four reunions. He was president of our class from 1968 to 1973. Sonny and his wife, Gloria, have four daughters who live within 75 miles of Boston. After many years of having a female dog, there is another male in the household—their dog, Jacob. Sonny changed his voting address to their summer home in Hull, Mass. He had been concerned about the sand dunes and had planted anything he could get to grow on the dunes in front of his house. The town appointed Sonny to the Beach Advisory Committee where he is learning about the geology and ecology of the beaches.

**Max Gellert** became president and CEO of ELDEC in 1971. In 1983 he was elected chairman of the Board. ELDEC's principal products are aerospace electronics. The stock is traded on NASDAQ, and their annual sales are \$104 million. Max served as director on numerous business, cultural, and civic organizations in Washington.

**Bob Lovezzola** spent 35 years selling chemicals, 22 with his own company. He didn't become convinced that he was a good salesman until he succeeded in selling the business. He expects to be fully retired by the end of 1989. He and his wife, Nancy, do a lot of selective skiing (good snow—good weather—no crowds). He plans to do perform some charitable work after retirement.

**Judith Turner von Huth** spent five years after graduation as an architect in New York and Illinois. In 1954 after marrying Stig von Huth, a Scandinavian architect, she moved to Sweden. In Sweden her architectural practice specializes in assistance to multinational corporations in Scandinavia. She has received architectural awards in office planning and for the design of an art museum and the design of a sports center. She and her husband have three children.

**Bill Weisz** celebrated 40 years with Motorola on October 18, 1988. After 10 years as president, he became vice-chairman and chief operating officer in 1980. In 1986 he became chief executive officer. He relinquished that role in a planned transition of corporate senior management announced two years earlier. He is now vice-chairman and Officer of the Board, a full time senior position with various major responsibilities—but not of a day to day operating nature. Bill and his wife, Barbara, celebrated their 41st wedding anniversary on December 25, 1988. They have three children and two grandchildren. Barbara and Bill enjoy playing golf. Bill serves on advisory committees to both the U.S. Secretaries of Commerce and Defense. He served two terms on the MIT Corporation, 17 years on the Sloan School Visiting Committee, and 14 years on the Electrical Engineering and Computer Science Visiting Committee where he was chairman for four years.

**Mike Kami's** recent book titled, *Trigger Points*, suggests ways to make decisions three times faster, innovate smarter, and beat your competition by ten percent (it ain't easy). Mike discusses: why the ultimate user of a product is more important than the direct buyer; why a rigid set of formulas for excellence won't work; why the price of staying in business is continuous innovation; and how your company can gear itself for innovation by running smart and lean. Mike consults with many companies including Harley-Davidson where our classmate **Vaughn Beals** is CEO. Vaughn's comment about Mike's book is, "If you can't have Mike's personal counsel, *Trigger Points* is the next best thing."

**Howard Smith** is president and CEO of Kurz-



weil Computer Products of Cambridge, a manufacturer of optical character recognition data entry equipment for the office systems market. Kurzweil is owned by Xerox. Recently Governor Dukakis reappointed Howard as chairman of the Massachusetts Technology Development Corporation (MTDC). MTDC is publicly-supported and privately-managed, and it provides venture capital financing to technology based companies. . . . **Ed Kratovil** sent a note as he left for Florida. He was dreaming of a "Green" Christmas. . . . **Richard Smith** is a consulting software documentation Engineer on the C-17A at McDonnell Douglas Electronics Systems Co.—**Marty Billett**, Secretary, 16 Greenwood Ave., Barrington, RI 02806

## 49 40th Reunion

A letter from the Institute of Electrical and Electronics Engineers announces that **Nat Sokal** has been elected a Fellow of the IEEE, "For contributions to the technology of high-efficiency power conversion and RF-power amplification." In a hand-written addendum, Nat says he is still running his electronics consulting company, Design Automation, Inc., in Lexington, Mass. He and his wife, Zeldia, are in good health and able to enjoy their children. Well they might considering that: A son, 34, has his PhD in theoretical physics from Princeton and is assistant professor of physics at New York University. He enjoys living in New York City. A daughter, 33, has her MD from the University of California Medical School at San Francisco and works in the field of public health in Berkeley, Calif. She and her husband, a lawyer, have a 2-year-old son. They love northern California. A second daughter, 31, has a master of architecture degree from the Harvard Graduate School of Design and works for an architectural firm in Boston. She and her fiancé, also an architect from HGSD, are renovating a 100-year-old three-story Victorian house in Brookline, Mass.

**Robert H. Ruth** in Philadelphia, Pa., writes that he retired on January 1, 1989, and that his wife, Barbara, retired from school teaching the previous June. They will be moving soon to the Finger Lakes region of New York. Daughter Ruth and husband Paul of Poughkeepsie, N.Y., have presented the Ruths with three grandsons. Daughter Lindsay, now in Syracuse, N.Y., is about to marry or will be already married by the time these notes reach you. Son Benjamin makes and sells violins and violas while son Nicholas is an artist and art teacher.

**Robert A. Barrows** reports that he retired from Westinghouse in Baltimore last summer. He states: "It is pleasing to see the talent and spirit of recent MIT grads." . . . **Warren K. Watters** writes: "In addition to duties as president of Reilly-Benton Corp., I am also serving as director of Whitney Holding Corp. and president of a foundation started in 1820 to sponsor a boys orphanage." Warren lives in New Orleans. . . . On the card containing his response to our 40th reunion questionnaire, **Walter Seibert** says: "We are retired and travel around six months of the year in our small recreational vehicle—hunt, fish, boat, and visit all the grandchildren."

The older we grow, the slower we go. Right? Well, not always. I offer **Geraldine Kunstader** as living proof that there are always exceptions to the rule. I remember Gerry as the beautiful Gerry Sapolsky who sat near me in a physics exam and hummed the Johnny Mercer tune "Personality" while I tried to remember whether you subtract dy from dx or just multiply them. Anyway, based on the evidence, Gerry is clearly growing younger. A piece of paper lying before me summarizes her activities in 53 single-spaced lines and I get overwhelmed just trying to absorb it all. However, I'll try to summarize her summary.

Geraldine serves on the Boards of Directors of nine well-known organizations including such diverse entities as the Menninger Clinic in Topeka, Kansas and the Institute of Current World Affairs in Hanover, N.H. She is, or has recently

been, a member of eight committees including the National Committee on United States-China Relations and the Visiting Committees for Student Affairs at MIT. Currently, she is on the advisory council for the east asian program of the School of Architecture. She is a trustee and chairman of the board of Windham College, Windham, Vt.; and a recipient of the 1970 Windham Award for Distinguished Service. She received the 1981 Silver Medal for Distinguished Service from the National Institute of Social Sciences.

Two main interests appear to have taken much of her time over the years: The United Nations and China. From 1969 until 1986, Gerry worked with the New York City Commission for the United Nations and Consular Corps. The Commission, part of the Mayor's office, is the official liaison between the City of New York and the 159 countries represented at the U.N., the largest diplomatic community in the world. Gerry's responsibility was to insure that all families of diplomats had suitable lodging with families she recruited from New York, New Jersey, and Connecticut.

As a China watcher, Gerry travels frequently to that country where, since 1983, she has been working with the Architectural Society of China in Beijing to assemble for them a comprehensive library of architecture and construction.

Gerry, and her husband John who is also an outstanding member of our class, have four children: John, Jr., Lisa, Christopher and Elizabeth.—**Fletcher Eaton**, Secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

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Having retired from active employment, Colonel **James O. Cobb** is now working for various charitable and public organizations including the U.S. Navy, the Air Force Association, and veterans groups while living in Rancho Palos Verdes, Calif. . . . Engaged in consulting following his retirement in 1980, **Willard W. Prince** is shuttling back and forth from his place in Vero Beach, Fla. He bought land there, and will relocate as soon as he completes the house that he is designing and building. . . . Deeply involved in community service organizations and the Society for the Advancement of Management since his retirement from the Aeronautical Systems Division at Wright-Patterson Air Force Base, **I. Victor Yancey** has just joined a new minority business venture, and is vice-president for management. He feels that it will take a while to get it off the ground.

Unfortunately, we have received word of the passing of a number of our classmates. . . . In January, **Walter O. Davis** of Brockton, Mass., died of a heart attack. A civil engineer, Walter worked with the Goldberg-Zoino Association, an environmental engineering firm. He had served as a fighter pilot during World War II before coming to MIT, and was active in our class reunion activities. Our condolences to his wife, Madeline, and their son and two daughters. . . . **Roger D. Harsch** passed away last July. Roger had lived in Weston, Mass., and worked for Raytheon. We send our sympathies to his wife, Margaret.

Chairman and CEO of the New York-based Syska and Hennessy, one of the nation's leading consulting engineering firms, **John F. Hennessy** died January 10. During his career, he supervised the engineering design of many of the country's outstanding buildings, including the Lincoln Center for the Performing Arts, Madison Square Garden, the Jacob K. Javits Convention Center in New York, and the John F. Kennedy Center for the Performing Arts. He had an impressive international practice with projects such as Singapore's Marina Square and the King Saud University in Saudi Arabia. John practiced engineering for 38 years, was licensed in 42 states, and was a member of the National Bureau of Engineering. He joined his firm after graduation, became its president in 1967, and chairman and chief executive officer in 1973. He was a member of the Visiting

Committee of the Sloan School and a trustee of the Harvey Mudd College. He leaves a daughter and five sons.

From Orlando we received word that **Maurice Ponti** passed away October 26, 1988. He had been a microelectronics engineer with the Martin Marietta Aerospace Corp. He had lived in Quincy and Winchester, Mass., before moving to Florida seven years ago. Our condolences go to his daughter and two sons.

Our final sad note comes from California, where **Kendall Peterson** passed away in December. He had been a noted meteorologist at the Lawrence Livermore National Laboratory for 19 years. His research focused on the dispersion and deposition of radioactive and other pollutants and their effects worldwide. He provided some of the first estimates of the iodine doses to which people in this country would be exposed following the Chernobyl disaster in 1986. He also provided the radiation exposure calculations related to the Three Mile Island accident in 1979. Most recently, he was the primary author of the paper "Internal Dose Following a Large-Scale Nuclear War" which was presented at a Moscow workshop last March. Our deepest sympathy to his wife, Barbara, sons David and Chris, and daughter Karen.—**Martin N. Greenfield**, Secretary, 25 Darrell Dr., Randolph, MA 02368

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I was saddened to learn that **Richard Quigley** of Orleans, Mass., died last December 2. He is survived by his wife Jane, a son, and two daughters. Two sons predeceased him.

On a happier note, **Art Turner**, who has worked for Baird Corp. since he left MIT, now has a new title there: chief engineer of the Analytical Instrument Division. Their big product is a behemoth machine called an inductively coupled spectrophotometer that will do quantitative analyses of minute amounts in jig time. It makes much of what we were supposed to have learned in sophomore chemistry obsolete. In my case, the actual loss is small.—**Richard F. Lacey**, Secretary, 2340 Cowper St., Palo Alto, CA 94301

## 53

When this reaches you, spring will be over and the end of the college year will almost be upon us. It's hard to think about approaching summer when you are putting these words to paper with the snow on the ground. That is a joke here in Washington. Here in the middle of February, the best we can achieve is rain and that does little for the skiing in the vicinity. This is the time of year when we generally have had enough of the poor winter and think of warmer climes further south, Florida, or maybe Mexico. We liked Cancun so much in early December, my wife and I plan to return in late March.

I have only a few short items this month, so I'll get to them. **Albert Lee** reports that his youngest and oldest daughters are at Duke University. The oldest is a senior studying computer science while his youngest is a freshman in biomedical engineering. His second daughter, who spent her freshman year at MIT, is currently at North Carolina State. Albert's work on amorphous metals has resulted in a commercial product line.

**Ben Coe** commends the reunion committee on the festivities and the selection of Nantucket as a location, which he last visited 35 years ago on his honeymoon. He asked about what happened to the plans for a reunion of the Logarithms. Anyone having knowledge of the missing Logarithms' reunion, please advise me and I'll pass the word along.

**Robert Godfrey**, who lives (or maybe lived is more appropriate) in Duxbury, Mass., has sold his business, R.S. Means Co. Inc., in 1984 and has retired to his 65-ft. ketch. He is currently in the middle of circumnavigating the globe. He has



reached New Zealand after spending a year and a half in Europe, the Caribbean and most of the South Pacific Islands between Panama and New Zealand. He plans to take another two and a half years to get back home. Bon Voyage!

And finally, it has been announced by the Allegheny Ludlum Corp. that **Dick Simmons**, chairman and chief executive officer, will step down as the chief executive officer of the corporation in May 1990. I imagine he is looking forward to a little slower pace.

That's all for now. Remember to keep sending those items in with your donations and other communications to the Institute. I do get them and I'll pass them along in follow-on articles. My address is listed below if you want to short circuit the system.—**Gilbert D. Gardner**, Secretary, 1200 Trinity Dr., Alexandria, VA 22314, (703) 461-0331

## 54 35th Reunion

**Bill Eccles** took a "brief break in an otherwise hectic day" to write with the information that he has accepted appointment as chairman of the Department of Electrical and Computer Engineering at the University of South Carolina. It's a temporary (18 months) appointment to deal with what he calls "administrivia" until a new chair from outside is selected. Last fall, Bill was appointed the Bellsouth Professor of Education through Telecommunications at U.S.C. His wife, Trish, is teaching at USC also, in computer science.

We have learned that **Tony Romano**, president of his own company in Springfield, Mass., has managed to stir up enough business in Florida to spend the winters there. During the summer, he lives in West Barrington, R.I. . . . **Mike O'Neill**, who is with Perkin-Elmer Corp. in Norwalk, Conn., has collected ten patents in the field of analytical instrumentation. . . . **Hugh Nutley** was a NASA faculty fellow at the Jet Propulsion Laboratory, Caltech, in 1985 and 1986. He continues to do consulting at JPL. . . . **Angelo Molinaro** has been with Sikorsky Aircraft Division of United Technologies Corp. since our graduation. He has written a book introducing a new theory of the universe and proposing a new theory of gravity.

**Marty Lubell** is with the Oak Ridge National Laboratory. He has a list of publications, presentations, and invited addresses that runs into the hundreds. His specialty is superconducting magnet technology. . . . **Jim Hazard** is a researcher for Scott Paper Co. in Philadelphia. His list of patents includes ten in the United States and one in Canada. He is also involved in sailing, furniture building, and genealogy. . . . **John Gusmer** is president of Filter Materials, Inc., in Waupaca, Wis. His company received the 1987 award as the outstanding small business exporter in Wisconsin.

**John Clauss** retired in 1987 from Lockheed in California, after 32 years there in various management positions. He has started an income tax preparation business to keep active. . . . **Marty Brilliant**, with Bell Labs, Inc., in New Jersey, spends his free time in amateur acting with the Monmouth Players in Navesink, N.J., and sailing. . . . **Peter Bishop** is in transition from managing his two small companies in the Portland, Maine, area to taking semi-retirement and spending his time investing in small companies. . . . **Bob Anslow** reports that he has moved from semiconductor to the force measurement business. He has joined Transducers, Inc., in Cerritos, Calif., as vice-president and general manager. His new company is, he says, the U.S. leader in load cells (for weight measurement) and advanced pressure sensors.

We hope that, by the time you read these class notes, your plans to attend the 35th reunion are complete. If not, let us hear from you right away. The reunion will be great fun for all, and we look forward to seeing everyone in Cambridge on June 8.—**Edwin G. Eigel, Jr.**, Secretary, 33 Pepperbush Lane, Fairfield, CT 06430; **Joseph P. Blake, Jr.**,

Assistant Secretary, 74 Lawrence Rd., Medford, MA 02155

## 55

I have the unhappy task of announcing that **Daniel Rothenberger, Jr.** died on February 13, 1987. He is survived by his wife, Annie, three sons, one daughter, and four grandchildren.

**Philip Untersee** informs us that he is vice-president of administration and finance for Arthur D. Little Decision Resources, a subsidiary of Arthur D. Little, Inc. He and his wife of 31 years, Mary, have been helping present engaged encounter programs (marriage preparation) for over ten years. He says its, "a great way to keep young."

**Harlan Walker** sent word that he is still disabled by chronic Epstein-Barr virus, but can still be active three or four hours a day on a limited basis.

**Joseph Carleton** sent a long account that I will report almost verbatim. He attends local alumni club events on a fairly regular basis. He and his wife are active in Neighbors Abroad and will be spending a week in Sweden in January 1989. They will also spend two weeks in Norway, Denmark, and the Netherlands before returning home. Joseph's work involves accident investigations in many different situations such as car fires, industrial accidents, building fires, explosions, water damage, and machinery and equipment failure. It's interesting for him to be on the other side of the drafting table for a change. He also teaches a car maintenance class for adult education twice a year. His wife puts on many plays in her first grade class and he photographs most of these events, something the flexibility of his job permits.

Joseph leaves us with the following thought, "The disparity between our standard of living and that of most of the other people in the world is distressing. Surely a country that can 'put a man on the moon' should be able to do something about rampant starvation, 50 per cent unemployment, \$1-2 per day wages in Guatemala, etc. How could MIT help in this?"

**John (Dick) Stopfel** was presented with the President's Historic Preservation Award by President Ronald Reagan on November 18. The award, given for excellence in privately-funded projects, recognized the Horticultural Hall restoration and rehabilitation designed by Stopfel Miller, Inc., architects and planners, located in Boston. This award was one of only 10 Presidential Award recipients, selected from entries from 45 states and Puerto Rico.

**Prentiss Cole** informs us that since 1955 he has worked in manufacturing, engineering design, graphic design, fine arts, stage and set design, in education, given talks about the need for new thinking about war and global security, and travelled. For the past eight years, and since its beginning, he has been working with the Beyond War Foundation. This is an international educational movement that is working at many levels to bring about the universal condemnation of all war as a way of settling conflicts. Last year, as part of an independent film team, he travelled for five weeks within the Soviet Union. The purpose was a television documentary that hopes to capture the spirit of the Soviet people through visual imagery, music, visits with artists, and historical sights.

Prentiss continues to serve as managing partner in an asset management business that survived the sale, in 1971, of Cole Rubber and Plastics, a manufacturing company started by his father when Prentiss was in high school and where he worked for 15 years. He has also returned to working in art as a sculptor, a career he interrupted 10 or so years ago to get into educational work that led to Beyond War movement. He further states that he has a fabulous family each of whom is interesting and full of life. Wife Lee, has been a friend and fellow explorer for 26 years.

Daughter Jeni, is completing her BFA at San Jose State University and Jeff is a sports fanatic and a junior in high school. The Cole's live in Los Altos, Calif. Prentiss plans to attend the 100th anniversary celebration at the Fiji House in April. We hope to hear more from Prentiss and the other Fiji's on how their celebration went and experiences for our class notes.

**Dell Lanier Venarde** gave us an update on her life. She is still teaching part-time at Delaware Tech and working at the Wilmington Library and Brandywine Creek State Park. Jack and Dell went to Australia and New Zealand last Fall and before that visited friends in Tasmania, Victoria, and on the South Island.

**Marty Gilvar** gave us news of his pending relocation to California. He retired at the end of 1988 and has put his home in Oakham, Mass., up for sale. As soon as it sells he and Meg will head for "The Foothills" area east of Sacramento and buy a house with an eight-car garage so he can play with his toys in the manner in which he has become accustomed. Their plan is to come back to the Vineyard house every summer so they won't lose track of their Eastern friends. Meg just finished the last of her courses at the University of Massachusetts for her master's in teaching of writing. Meg and Marty travelled to China in January and to Taiwan in June. The kids are fine. Ted (22) graduates from SMU in May, Jenny (27) and her husband and kids have built a home right around the corner in Oakham, and John (29) has gone back to graduate school at the University of Texas in Austin.

**Dick McCammon** started off with a bit of unusual news with the fact that their family celebrated Christmas in May. Their reasoning was that since travel was so hectic and unpredictable over the regular Christmas season that May would be better. Ian came from the University of Utah where he is closing in on a PhD in robotics. Daughter Catherine arrived with a broken collar bone and abrasions from a bicycle accident from Vancouver. She is hoping for a renewal of her three-year NRC University research fellowship. Dick's wife Helen slipped and broke her wrist on Halloween eve so it was a year of broken bones for the McCammons.

Dick and Helen traded being the spouse on each other's trips. In July, Dick was the spouse as Helen attended the Permafrost Conference in Norway with a one-week field trip to Svalbard at 79 degrees N, which is the furthest north they had ever been. In November, Helen was the spouse as Dick participated in a Mineral Resource Workshop in Sotogrande, Spain. The highlight was the weekend visit to the magnificent Alhambra in Grenada then a short trip to the Sierra Nevada. Dick continues his development of expert systems in mineral resource evaluation at the USGS and Helen continues to direct the Ecological Research Division at the Department of Energy.



**Gordon Lohman, '55**

**Gordon Lohman** keeps moving up the ladder at AMSTED Industries. Last year we announced in this column that he was executive vice-president and now I'm happy to announce he has been named president and chief operating officer, ef-



fective December 13, 1988. Gordon has been with AMSTED for 33 years. He and his wife JoAnn are the parents of two daughters and reside in Barrington Hills, Ill.

It was great hearing from so many of you.

Please continue to send us your thoughts, views, news, family experiences—whatever. We all become a little closer when you do.—Co-secretaries: **Robert P. Greene**, 37 Great Rock Rd., Sherborn, MA 01770; **DuWayne J. Peterson, Jr.**, 201 E. 79th St., New York, NY 10021

## 56

**Fred B. Bialek** of Woodside, Calif., was one of the early employees at Fairchild Semiconductor (1959-1967), where he was vice-president of international operations for the last three years. He then became one of the top management team that took over National Semiconductor, where he was vice-president of international operations and sales until 1971 and subsequently became vice-president of the National's System Division till 1981, when he became president of a computer and disk drive start-up. In 1986 he began consulting, specializing in mergers and acquisitions with his largest assignment the National Semi acquisition of Fairchild Semi in 1978-88, which involved diligent negotiations for the consolidation of the two companies.

**Joseph F. Hamlet** of Lake Forest, Ill., continues to be actively involved in building safety and Kleen Corp.'s business internationally. He is strongly involved in the Pacific-Rim countries and additional penetration into Europe. . . . **Ellen W. Harland** provides an update. She started a new life in Washington, D.C., leaving the dachshund and marmalade cat and lots of good friends back in Santa Fe to work at the perfect job with the U.S. Architectural and Transportation Barriers Compliance Board.

**Robert A. MacDonald, Jr.** is pleased to announce that his son, Andrew, graduated in June with the class of '88 earning a degree in computer science. That's the good news. The bad news is that he has taken a job in the Boston area about 3,000 miles from Bob and Mary and Los Angeles. Bob is working at Northrop on the B-2A program and resides in Whittier, Calif. . . . We hear that **Jory Schlenger** and **Joseph Good-**will also had children in the class of '88.

**Reverdy E. Wright** is still busy working for the Army Material Command in information management. Lydia, his wife, is on the staff of George Mason University. His daughter Tamara received a master's degree last June (along with her husband) in engineering mechanics from Virginia Tech, where she stayed on as a member of the staff. Reverdy and Lydia live in Alexandria, Va.

**Robert F. Santos** is retiring from AT&T after 33 years. His final assignment was vice-president of Systems Integration Marketing. Bob plans to establish his own business. . . . We received word that **Donald C. Bressler** died on December 19, 1986 (Route 1, Box 19, Marquette, NE 68854).—Co-secretaries: **George H. Brattin**, 39 Bartlet St., Andover, MA 01810, (508) 470-2730; **Irwin C. Gross**, Sweets McGraw-Hill, 1221 Ave. of the Americas, New York, NY 10020, (212) 512-3181

## 57

I start these notes with an explanation for their absence over the past few months. Last December, I underwent a six-fold coronary artery bypass operation at the Beth Israel Hospital in Brookline. Everyone, including the cardiologist, was surprised at the extent of the existing blockage, and it was certainly a trying time for family and friends, as well as the patient. Fortunately, the problem was caught before I had a heart attack, and I am now feeling fine and exercising regularly to get my stamina back. Needless to say, some matters, such as preparing class notes, did not get done for several weeks.

Two pleasant notes are that in February I became a vice-president of Stone & Webster Engineering Corp., and last fall The Boston Society of Civil Engineers Section of the American Society of Civil Engineers elected me an honorary member.

**Dan Schlitt** writes that, after 22 years at the University of Nebraska, he has moved to the New York area, where he administers the Science Division Computer Facility of the City University of New York. . . . **Richard Kain** is the director of Graduate Studies in the Electrical Engineering department at the University of Minnesota, where he is a professor. . . . **Boyd Givan** was elected vice-president for finance of the Boeing Co. last October. . . . **John Penhune** is a group senior vice-president of Science Applications International Corp., in San Diego, where he manages a research group of about 200 professionals. They are very involved in neural networks and are manufacturing a neurocomputer.

**Bob Rosin** and his wife, Rosalie, celebrated their 25th wedding anniversary with a trip to China. Although it was not a business trip, Bob did give a lecture on "Communication System Architecture" at the University of Post and Telecommunications in Beijing. Another highlight of the trip was a meeting with the All China Women's Federation.

**Lester Gimpelson** writes that he retired last July. He can be reached at his home address in Brussels, where he has been living for the last 15 years.

Last summer several items appeared in the newspapers describing the attempts of **Don Norman** to introduce some common sense into product design. He is the director of the Institute for Cognitive Science at the University of California at San Diego and has recently published a book, *The Psychology of Everyday Things* (Basic Books). His concerns are items such as digital watches and VCRs, which can only be operated by "someone with a degree from MIT." Don argues that proper design of controls, with some thought for the user's frustrations, could improve everyone's quality of life.—**John Christian**, Secretary, 23 Fredana Rd., Waban, MA 02168

## 58

Well, spring is fully upon us—the grass is green, the flowers are blooming, and the Bushes are in the White House. Ain't it just grand? To make you feel even happier, we have lots of good news this month.

At the reunion, I had a chance to talk with **Mac Jordan** about his mid-life career change from his 26 years in the petroleum business. He has returned to the university environment as chairman of the Business and Management Department in University Extension at the University of California at Berkeley. In making this move, Mac said that he had great help and support from both a career counselor and his wife, Mary. Additionally, Mac and Mary were able to return to their original hometown, and they feel that the overall rewards from the change have been exceptional.

We received a nice note from **Charles Blaney** telling us that "after 26 years of interesting employment with Honeywell/Honeywell Bull, I accepted a 'golden handshake/nudge' contract and left. I still enjoy the computer field and am currently employed by a small, successful, energetic company. Good change for me! My interest in athletics continues. I still play competitive softball (despite what my younger colleagues say) and run road races. MIT remains one of my most rewarding experiences" . . . Another of our class athletes, **Ed Sullivan**, has continued to coach community basketball, baseball, and soccer teams. He has also been active in his church as past president of the parish council, religious education moderator, and (with his wife Kathy) a marriage preparation adviser. Ed and Kathy have four children between the ages of 17 and 26. Ed

has been a manager at Bethlehem Steel Corp. in Maryland for many years and has also been active in the Steel Section of the AIME.

Still another career change, this one for **Joel Klein**, who wrote that "after 25 years as a research physical chemist at the U.S. Army's Chemical Research, Development and Engineering Center, I accepted an early retirement offer to devote myself fully to my accounting practice. I am also teaching math and business at a local college. This past October, my wife and I spent several weeks visiting our daughter, Rivka, and her husband at their new home in Jerusalem, Israel. With my newfound freedom, we should be able to visit them more frequently.

Considering the time lag before publication, congratulations are undoubtedly in order for **Greg Lazarchik**, who wrote that he was "about to become a grandfather for the first time. Currently, most of my time is occupied at PPG in the pursuit of new business development through international development, as well as mergers and acquisitions, with the annual diversion into the depths of strategic planning. Every once in a while, I see Joe Goodwill, '57, on the streets of Pittsburgh" . . . **Arthur Aronson** has assumed a new position as executive vice-president of Allegheny Ludlum Corp. Previously, he was president and COO of Lukins, Inc., a steel company in Coatesville, Pa. . . . **Toby Carlson** is a full professor at Penn State University. Recently, Toby and his family took a sabbatical, which they spent in France at CNET/CHRS outside of Paris.

**Larry Kaiden** is the president of Winfield-Flynn, Ltd., in New York City, a retail wine and liquor merchant that also sells gifts by mail-order catalog throughout the U.S. He also owns and operates commercial property in New York City. A serious skier, Larry received the Schier Ski Award and also achieved the status of First Grand Master of Heli-Skiing. Larry and Diane were at our 30th reunion. They have two children, Michael (14) and Steven (11). . . . Also at the reunion were Ann and Ed Newton. Ed was previously with Gleason Works in Rochester, N.Y., but left to become general manager of the Vinton subsidiary of Hydro Acoustics/Vinton Co., which makes plastic welding machinery and tooling. Ed continues to be active on the Educational Council for MIT and is an elder in the Presbyterian Church.

During the reunion we had a chance to talk at length with **Eddie Changkasiri** and his charming wife, Somwong. Currently, Eddie is deputy permanent secretary of the Ministry of Industry, Department of Mineral Resources in Thailand. He was formerly director general of this group, which negotiates petroleum concessions and prospecting/mining licenses with mineral companies that wish to operate in Thailand. Earlier, he was secretary general of the Thailand Industrial Standards Institute. Before that, he served as deputy director general in Thailand's Department of Industrial Promotion. In addition, he serves on the board of directors for the Petroleum Authority of Thailand, the PTT Exploration and Production Co. Ltd. Some classmates may also recall that Eddie was an Eisenhower Fellow in Washington, D.C., in 1969. Like Eddie, Somwong came to the United States on a Thailand government scholarship and then returned to work for the Thailand government for five years. She joined the United Nations in 1965 and has been working with the Economic and Social Committee for Asia and the Pacific. They have three children, all of whom are in college. Their daughter Sansanee graduated from Nahadol University in Thailand and is working toward a Ph.D. in molecular biology at Georgetown University. Their other daughter, Sirriat, is on the law faculty at Thammasat University in Thailand. Their son, Padhanasath, is studying chemical engineering at the Royal Melbourne Institute of Technology in Australia.

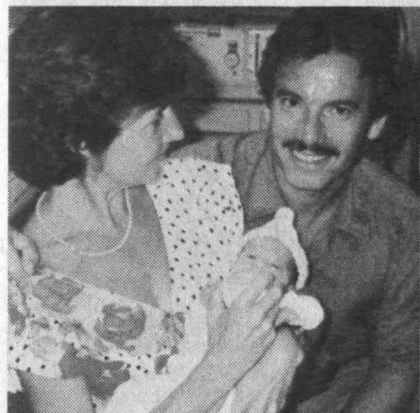
Speaking of reunions, **Ken Auer** sent a letter saying, "With one remaining high schooler in the nest, Linda and I could not make it to the 30th, but we're planning on the 35th. Because our class



appears to be at the mid-point between the newest class and the oldest, does it mean that we've made it halfway or that we have halfway to go? Muse on that, '58ers!' . . . On that note, we will sail into the sunset—until next month.—**Mike Brose**, Secretary, 841 Magdeline Dr., Madison, WI 53704

## 60

I recently received a newsy letter and photo from **Michael Kasser**, who is now a resident of the Aloha State. Mike and his wife, Beth, are the proud new parents of an adopted daughter, Violet, born in November 1988. Mike said that he and Beth moved to Hawaii to train for Triathlons, but that their many other activities have taken a toll on the time available for competitions. Mike continues to look for investment opportunities in Hawaii real estate, stocks, and venture capital. Beth's activities include a broad range of education-related pursuits and establishing a Kona coffee mail-order business. Mike said he'd enjoy hearing from classmates visiting Kona.



*Mike, '60, Beth, and Violet Kasser.*

**Andrew Larsen** sent me a letter with the sad news of the tragic death of classmate **Leonard Isaacs** in an automobile accident in August 1988. Leonard was a professor in the Lyman Briggs School of Michigan State University specializing in the history of science, science and public policy, and science fiction writing. Leonard is survived by his wife, Katie See, and their infant daughter, Jillian. Andrew wrote that Lenny loved to travel and that he had at least one memorable trip to Austria and Germany that was the inspiration for a similar trip to Drew Larsen. The MSU press release on Lenny also noted that he was a Fellow of the Institute of Society, Ethics, and Life Science who was recognized for "his love of truth."—**Frank A. Tapparo**, Secretary, 15 S. Montague St., Arlington, VA 22204

## 61

For the last couple of years **Gus Solomons** has been sending me his newsletter. As nearly everyone knows, Gus is a marvelous dancer and choreographer with his own company in New York. The Solomons Company is prominent in New York dance circles, and last year was invited to perform in the Joyce, a premier dance theater in New York. During the summer they danced on Martha's Vineyard, to excellent reviews. Gus was commissioned by Hayes & Co. (in New Hampshire) to choreograph a new ballet. Then the U.S. Information Agency sent Gus to Tanzania to teach about "post-modern" dance in the U.S. He is going back this summer. Gus's company has been chosen by the North Carolina Arts Council as members of the National Touring Roster. So af-

ter some lean years, Gus and his people are getting proper recognition. The newsletter is always interesting, and those of you in the New York area might be interested in getting on his mailing list: The Solomons Company/Dance, Inc., 889 Broadway, New York, NY 10003.

**Harold Heggstad** writes that he is assistant leader of the Machine Intelligence Technology Group at Lincoln Labs. His team is developing expert systems for control of worldwide military communication networks. . . . **Leo Heiblinger** also wrote. He says: "For the past eight years I have lived with my wife Yueh-Hui and son Chao-Wen in the Far East, working for Sandvik, a Swedish company. We spent the first three years in Japan and the past five years in South Korea, where I am director of Sandvik's Process Systems Division. In 1989 we are going to move again, to Hong Kong, where for the next few years I will be active in developing the China market." Good Luck, Leo. . . . **Craig Temon** writes that he is now the senior vice-president in charge of technology at Noranda, Inc., in Toronto. He's been there since March 1987.

A wild letter from old pal **Bob Pease**. He included his list of abandoned cars seen along the California freeways (Silicon Valley Division) for the last 19 years. Here is a sample: 307.5 VWs (two were pre-1958), 134.5 Toyotas, one Maserati-Biturbo, 11 Jeeps, and so on. He says that a total of 2,227 U.S. and 1,327 imported cars were abandoned. He also counted 208 flat tires, 10 abandoned buses, and one car on fire. He saw 516 cars with only one brake light. Bob, I think there is a denominator missing somewhere. Does anyone else keep track of this sort of thing? Next issue I'll report on Bob's recent publications in the field of analogue circuit trouble shooting. Quite interesting.—**Andrew Braun**, Secretary, 464 Heath St., Chestnut Hill, MA 02167

## 62

Our class president for 25 years (that's even better than FDR) **Bardwell C. Salmon**, better known to us as Boje and to his colleagues as Bard, has become president and CEO of Laser Plot in Auburn, Mass. The company is "a world leader in integrated navigation systems for the marine industry." Bard says that he is really enjoying the role of small-company entrepreneur in the exciting new field of "digitized electronic charting." Now if that can improve his sailing skills, we will expect to see him with an entry in the America's Cup. We wish him well with the challenge of the new job.

**Barry J. Fidelman** has joined Atlas Venture as general partner of the venture capital firm in Cambridge, Mass. Atlas handles a portfolio of about \$100 million in capital investments in European and U.S. companies. Atlas was founded in 1980 in Amsterdam, The Netherlands, and its U.S. operation was established in 1986. Before joining Atlas Venture, Barry was president of the International Division of Alliant Computer, and has held various executive jobs with Apollo Computer (1981-85) and Data General Corp. (1969-81). Barry received his MBA from the Harvard Business School in 1964. Atlas Venture's portfolio includes participation in Automation Technology Products, Campbell, Calif.; Bachman Information Systems, Cambridge, Mass.; Concord Communications, Marlboro, Mass.; David Systems, Inc., Sunnyvale, Calif.; Gold Hill Computers, Inc., Cambridge, Mass.; Microgenics, Concord, Calif.; Osteotech, Inc., Shrewsbury, N.J.; Sequent Computer Systems, Inc., Beaverton, Oreg.; and The Wollongong Group, Inc., Palo Alto, Calif. (maybe this last one has some connection with Australia?).

**Philip H. Nelson** writes that he is currently working with the U.S. Geological Survey on geophysical problems associated with mineral resources and waste disposal. . . . **Philip Hudock** has opened a new law firm in Washington, D.C., specializing in entrepreneurial clients primarily in

the computer hardware/software industry. He is serving this year as chairperson of the MIT Enterprise Forum and is the secretary of the MIT Club of Washington.

**Allan Scherr** writes that he was recently promoted to vice-president of IBM's Application Systems Division. (Go, Big Blue!) He will be responsible for systems application architecture and the division's technical staff. Allan is also an IBM fellow, an honor he shares with, among others, **Dean Eastman**. Allan reports that he frequently sees his old 6.06 lab partner **Gary Helmig**, who is also a long-time IBMer. Perhaps someone could tell us just how many of our classmates currently work for the Bluest of the Big Blue Chips?

A professional friend was surprised recently when he found that I was a graduate of MIT. He told me that I was "the first MIT graduate [he knew] who did not wear his MIT ring [the old brass rat] regularly." Do we know what percentage of the class of 1962 wears the school ring regularly? That might be a good question for the latest version of Trivial Pursuit.

So what news do you have for the class notes? Send word along with your donations to the Alumni Fund, or tear out the form from your next issue of *Technology Review*. Your classmates really are interested in what you are doing to make yourself rich and famous, or even poor and infamous. Drop a note to: **Hank McCarl**, Secretary, P.O. Box 352, Birmingham, AL 35201-0352

## 63

My mailbag is a little thin for this time of year, but happily most of you included addresses for me to pass on to our classmates. . . . **John Brach**, who is living in Dunwoody, Ga. continues as chief engineer of the Atlanta rapid transit system. His son Brian is finishing his 'freshperson' year (what we used to call freshman; does anyone have a better non-sexist word?) at Wake Forest, in a pre-med program. . . . **Kenneth Klein** also lives in Georgia. He "finally did it. Couldn't take the single life anymore . . . [got] married January 28 to Barbara Schlefman and is moving into a new house in Roswell."

San Diego, Calif., is the home of **John Lambert**. He tells us his daughter is a sophomore at the Tute, majoring in architecture and civil engineering.

**Mike Chessman** is now with Varian Associates in Palo Alto, Calif., about ten minutes from his home. He's been at Varian about two years now and manages manufacturing engineering. His division makes x-ray therapy equipment for treating cancer. Mike's older daughter is finishing her sophomore year at the University of Wisconsin (Madison), and is interested in archeology and history. His younger daughter is finishing seventh grade and is interested in horses. "Life is pretty good. Not much excitement except keeping up with our two kids." Having two of my own, I know that is plenty of excitement.

There are some remaining copies of the class book printed up for the 25th reunion. It contains one-page autobiographies (with photographs) from several hundred of us. I found reading it informative and often moving. Ken Anderson has them, for ten bucks a copy, first come, first served. Call him, please, at (617) 235-9530 to get your copy if you don't already have one.—**Phil Marcus**, Secretary, 3410 Orange Grove Ct., Ellicott City, MD 21043, (301) 750-0184

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### 25th Reunion

Hopefully, as you are reading this, you are also in the final stages of planning for your trip to our 25th reunion. If not, call your friendly airline right away and come join us in Cambridge, June 8-11.

**Doug Haith**, who is a professor of agricultural engineering at Cornell University, won the 1988



American Society of Civil Engineers' Wesley W. Horner Award for his achievements in environmental engineering. He was recognized for co-authoring a paper on the disposal of municipal sewage treatment plant sludge. Doug has also authored the book *Environmental Systems Optimization* and co-authored *Water Resource Systems Planning and Analysis*. He earned an SB and SM in Course I and a doctorate in civil engineering from Cornell. Doug is currently living in Trumansburg, N.Y. . . . **Frank Darmory** was elected president and a director of Alcide Corp. of Norwalk, Conn., a manufacturer of specialty chemicals, biocides, and pharmaceuticals. Frank is currently living in Westfield, N.J.

Evelyn and **Patrick Gage** welcomed the arrival of their second son last September. It was a surprise emergency home delivery with no physician present; only Patrick and their two-year-old son were in attendance. Congratulations! . . . **Dennis Smith** writes from Palo Alto that he is vice-president for product development at Molecular Design Ltd., a computer software company specializing in chemical information systems for industrial and academic research scientists.

Our final item comes from **Michael Godfrey**, who has been in Omaha for two years as a result of Union Pacific's purchase of his former employer (Missouri Pacific Railroad). In 1986, Mike headed the team that put together the operating plan for the merger of the Missouri-Kansas-Texas Railroad into the Union Pacific. The plan was part of the overall merger application submitted in November 1986 and approved in August 1988. Mike is now the quality program manager at Union Pacific, working on a comprehensive quality program aimed at improving service, maintenance, repair and asset management.

The Godfreys' "No. 3 son" is a Cub Scout, so Mike is staying busy as a first-time Webelos den leader. He and his son are also taking beginning piano lessons together. Mike is an educational counselor for the Omaha area. He describes the current crop of high school seniors as impressive and wonders if he could get into MIT today. Finally, Mike joined a local Toastmasters International Club and has noticed real improvement in his public speaking. Mike's schedule sounds like a busy one.

For those of you whose schedules are too busy to fit in the reunion, please send me a note with your news. Thanks.—**Joe Kasper**, Secretary, 3502 Idaho Ave., N.W., Washington, DC 20016

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**Dave Ljungquist** has been busy for the past two years. He joined a start-up, Nitech, as regional manager, and his wife, Carol, graduated from law school and began a clerkship at the Connecticut Appellate Court. He says that he's getting close to a "life re-start"—the kids have moved out and he's down to only six pets.

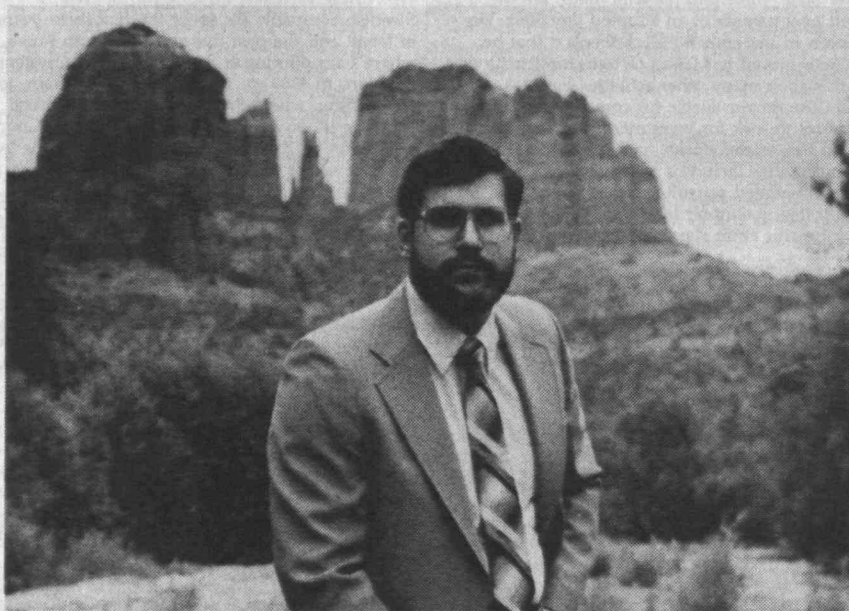
**Robert Poole** reports that his think tank, the Reason Foundation, celebrated its 10th anniversary in November with a black-tie dinner in Los Angeles.

After obtaining a master's degree from Indiana University, **Mark Schwartz** went to work for Smith Kline and French Labs in Philadelphia. He worked as a medicinal chemist for nine years. With an MBA from Drexel University, he transferred to the marketing division, where he was recently named group product director for gastrointestinal products.

**Joseph Bravman** writes that he and his wife, Ellen, have a daughter who just turned 1 year old, as well as two boys, 6 and 3. He is still president of Fairchild Communications and Electronics Co.

There is plenty of class news now, but, by the time you read this, it will start to taper off into the summer when everyone has "better" things to do. Remember your classmates—send some news.—**Jeff Kenton**, Secretary, 7 Hill Top Rd., Weston, MA 02193

## Applied ESP



Pete Sanders, '72, Sedona, Ariz.

Everyone is psychic, says Pete A. Sanders, Jr., '72, in his new "how to" book, *You Are Psychic!*, published by Rawson Associates, New York. But often our extrasensory abilities go untapped he believes, partly because early education teaches us to pay attention to our physical senses to the exclusion of the psychic ones.

Developing and using one's psychic senses can be beneficial in a variety of ways, says Sanders, citing numerous examples, including his own ability to sense what material would be covered on his MIT exams.

Sanders describes four principal psychic types and their receptive areas: the "feeling" center located in the solar plexus, the "intuitive" center at the top of the head, the "hearing" center above the ears, and the "visual" center in the forehead. Individuals tend to have stronger abilities in one or two of the areas, and Sanders outlines each type and provides exercises for further development in all four areas.

Audients, he says, are the most analytical of the four types and the least likely to think they're psychic. They may just think they're talking to themselves inside their heads when actually they are receiving psychic infor-

mation. Intuitives, or "prophetics," tend to be spontaneous and are best at sensing the future. That's because intuition, a kind of instant knowing that comes in flashes of insight, is the fastest and least limited of the psychic senses, says Sanders.

In addition to tapping the psychic senses, Sanders advocates developing one's awareness of auras. "I am often challenged about my belief in auras," he reports. His reply: "Seeing is believing. I know that auras exist because I see them, and I use the information I get from them every day of my life." Sanders thinks of the aura—a glow of colors around a body—as a "psychic x-ray" that reveals a person's mood, intentions, health, feelings, and motives. Aura sensing takes practice, but anyone can learn to do it, he assures readers of his book.

To teach people techniques for developing their psychic skills and self-healing abilities, and to further explore extra dimensions of the soul, Sanders founded Free Soul, a non-profit educational program based in Sedona, Ariz. The organization has an outreach program, with about 200 instructors throughout the United States.

How does Sanders reconcile psychic



and spiritual phenomena with his science background? (He studied biomedical chemistry and brain science at MIT and graduated in the top 10th of his class.) Many aspects of modern science are stranger than metaphysics, he maintains. Time and again in his studies at MIT, he faced scientific facts and ideas that seemed to defy common sense, including relativity, electron tunneling, and neutrinos.

"Science and spirituality recently took a giant leap to close the gap between them with the development of a new theory of the universe and subatomic physics—the Superstring Theory," says Sanders. He explains that its mathematical foundation requires the existence of ten dimensions—the three spatial dimensions (height, breadth, length), the fourth dimension of time, and six others still beyond our ability to identify.

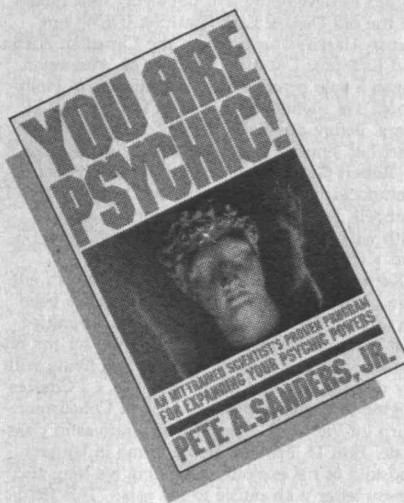
He recalls a demonstration at the Seattle World's Fair where a man was unharmed when a million volts of electricity passed through his body. The explanation given was that even though the voltage was high, it was at a frequency that did not harm human tissue; it resonated at a level different from the vibrations of his physical cells.

The demonstrator suggested that a similar principal might be working between the spiritual and physical dimensions—that God, the soul, or things spiritual may exist but be out of phase, out of sync, or in a different dimension from the physical reality we are used to. "It was my first exposure," says Sanders, "to the concept that science and spirituality need not be enemies—that the two can coexist, that one can explain the other, that they can be two sides of the same coin."—*Sandra Knight* □

*Excerpts from You Are Psychic!, Chapter 10 ("Answers to the 36 Most Common Questions about Psychic Phenomena")*

#### **Why aren't laboratory experiments with ESP more successful?**

Overall, the ESP experiments carried out in the past and those currently in progress are successful. The results



**You Are Psychic!** by Pete A. Sanders  
is published by Rawson Associates.

produced by the pioneering work of J. B. Rhine at Duke University in the early 1930s and the experimental work currently under way at Stanford Research Institute indicate substantial statistical evidence for the existence of psychic phenomena. Some of Rhine's subjects, who psychically "guessed" symbols on unseen cards, had an accuracy score twice what pure statistical chance would have yielded.

More dramatic evidence is harder to come by in a laboratory, since a lab is a poor setting for testing psychic perception. Most of the people I tested at MIT became extremely tense under laboratory conditions. Their auras constricted; I could literally see their psychic sensitivity shutting down. Life situations are a much better setting for practicing and exploring ESP.

#### **I don't want to know about bad things that are going to happen. Why should I want to be psychic?**

This viewpoint is common, but it doesn't make sense. Warnings of trouble ahead are always helpful. The future is not predetermined. If you have timely warning, any event can be altered or avoided. The warning can help you prepare for whatever difficulty may be coming. Accidents, if not preventable, can be minimized.

Remember that only a small part of psychic ability deals with warnings; ESP is as easily used to sense positive opportunities. Don't think of psychic ability as just a defensive mechanism. It is equally a tool for creating your own destiny.

#### **You talk about four personality types based on ESP strengths. Is any one of them more psychic than the others?**

Not really. Prophetics and feelers appear to be more psychic, but that is generally because the forms of ESP that are their strengths, psychic intuition and psychic feeling, are what most people tend to think of as ESP. Visionaries and audients seem less psychic because the way they receive ESP is closer to so-called normal thinking processes.

#### **How can I tell if a feeling is a psychic warning or just my own inner fears?**

Note the exact location of your impression. A psychic feeling signal will usually be experienced mainly in the solar plexus. This is often referred to as having butterflies or a "sinking" feeling in the pit of the stomach. A fear that is *not* based on a psychic warning will usually stimulate an adrenalin-triggered fight-or-flight physiological reaction. Adrenalin makes your heart race, shortens your breathing, and raises your blood pressure.

#### **How can I help my children avoid suppressing their psychic ability?**

Communicate with them on psychic frequencies. Project images along with your physical directions when you teach them new skills. Send a thought or voice psychically before you call a child. Do not require your child to use only rigid logic in dealing with life. Allow the expression of feelings. Teach children about the psychic senses. Tell them everyone has nine senses, not just five, and encourage them to use all nine. Games are another way to teach them. For example, you might suggest a game of psychic hide-and-seek and challenge the youngsters to use their intuition or feeling to help them find you. □



After a 20-year stint with Analytics, Inc., where he was the executive vice-president and chief operating officer, **Sydney Martin** has recently formed a new corporation, Sytex, to provide technical consulting to the Department of Defense. . . . **Chuck Kolb** has been elected fellow of the Optical Society of America. . . . **Richard Haberman** has returned from a sabbatical in Australia and lecturing on applied mathematics in Beijing. He is a professor of mathematics at Southern Methodist University.

From 1981 to 1988, **Paul Flanagan** was director of data processing at Christian Broadcasting Network. He is now head of a small firm, Information Innovators, whose first product is a telephone fraud reduction device that stops people from making unauthorized long-distance calls through telephone switches. Paul also teaches part time in the business school at CBN University. His wife, Maureen, is a free-lance newspaper reporter and instructor at Old Dominion University, and their son Mark is a sophomore in aerospace engineering at Syracuse University. . . . **Jeff Schoenwald** writes that in October 1987, he attended a NATO workshop on robotic sensors in Costa Brava, Spain. He found Costa Brava a dream he would like to revisit. Jeff is currently manager of the Sensor Technology Department of the Rockwell Science Center in Thousand Oaks, Calif. . . . **David McClain** proudly announces that his son John received an early Christmas present in 1987 with early admission to MIT. ("I'm glad they are willing to take another McClain!" John told everyone.) David is now reliving many memories of freshman year and reports that some things haven't changed a bit. . . . Last year was filled with travel for **Mike Zuteck**. He spent a little over one-third of the year in transit or "on location." The high points included New Zealand for some America's Cup reconnaissance; Newport, R.I., for the Tornado catamaran Olympic trials; and Bay City, Mich., for his 25th high school reunion.

**Larry Burgess** is the chief engineer at Flam & Russell, Inc. in Horsham, Pa. He directs company efforts in special antennas, RF components and subsystems, direction finding, adaptive arrays, radar cross-section measurements, and radar target identification. Larry has been with the company since 1982. . . . **Pat Confalone** is chairman of the Organic Division of the American Chemical Society. He has also been named director of research in medicinal chemistry at Du Pont Pharmaceuticals.

**Joseph Klawnsnik** is in private practice as a psychologist, specializing in marriage, family, and divorce counseling. . . . **Donald Mattes** reports that Savant Instruments, where he is president, has been sold to a British holding company. Don now has a boss for the first time in three years. . . . **Marc Levenson** has been named a fellow of the IEEE and traveled to New Zealand in January to see if the 20th century can be survived.—**Jim Swanson**, Secretary, 878 Hoffman Terr., Los Altos, CA 94022

## 20th Reunion

Why bother writing these notes when I could hand them out on a sheet at our 20th reunion, which will occur shortly after you receive your May/June Review. Well, I suppose there will be one or two folks who won't be there for the big 20th, June 8-11, so for your benefit. . . . We hear from **Mark A. Wuonola** of Wilmington, Del., that he married Jill Evans in August 1986, and that they are now expecting their first child. Since March 1988, Mark has been research manager, medicinal chemistry, in the pharmaceutical and biotechnology R&D division of Du Pont's Medical Products Department. In addition to managing activities in four therapeutic areas, he has responsibility for NMR, mass, and optical spectroscopy,

and kilo lab operations. . . . **Mark A. Rockoff**, M.D., writes that he is still at the Children's Hospital in Boston and has recently been named vice-chairman and clinical director of the Department of Anesthesia. He is also an associate professor of anesthesia (Pediatrics) at Harvard Medical School.

Air Force Lt. Col. **David A. Herrelko** of Westford, Mass., has been selected for colonel. He is now program director, North Warning System, involved in developing and deploying new radars on the old Distant Early Warning (DEW) line across Alaska's North Slope, the Canadian Arctic, and Labrador Coast. . . . **Jeffrey M. Weissman** began a solo practice as a civil litigator in Hollywood, Fla., where he has lived for the past 11 years. Before opening his practice he wrote, "I have had enough of the large law firm practice." . . . **Robert Ganssle** is currently vice-president of manufacturing for the Kerite Co., a subsidiary of Hubbell, Inc. He lives in Huntington, Conn., with wife Paulette and two daughters, Dana (7) and Kara (2).

**Kathryn K. James** writes, "I'm in the 16th edition of *Who's Who of American Women*. I've been serving on the AFCEA membership committee and work occasionally at a thrift shop for the National Council of Jewish Women. Still living with my dog and cat in Annandale, Va." . . . **Charles Raymond Smith** is now working at Concurrent Corp. in Westford, Mass. Former aero/astro classmate, **Paul D. Epstein**, wrote to me in January and told of his exploits, beginning his long and newsy letter with music to my ears: "This fall I read *The Quickening Universe* and decided I had to write to tell you how much I enjoyed it. Time spent reading it was an intellectual reward."

And for that nice promo, I'll report that Paul's book, *Using Performance Measurement in Local Government*, was published in 1984 by Van Nostrand Reinhold, and in April 1988 the National Civic League re-issued the book as a paperback. Leaving the New York City mayor's office in the fall of 1985, Paul and his wife, Suzanne Fass, started a "mom and pop" consulting firm (Epstein and Fass Associates) that specializes in performance measurement and productivity improvement of public services. Their clients are government agencies, universities, and non-profit organizations. Paul has also taught at the NYU Graduate School of Public Administration and last spring was elected president of the New York Metropolitan Chapter of ASPA (American Society for Public Administration). Paul has promised to tell us two hilarious jokes at the class reunion, so y'all come and listen up now.—**Eugene F. Mallove**, Secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03301

**John Wurts** is now chairman, president, and chief executive officer of Symbolics, Inc., in Cambridge, Mass. . . . **Louis S. Zarfes** in 1984 received his juris doctor from the National Law Center, George Washington University, and passed the Virginia bar exam. Later that year, he was diagnosed as having multiple sclerosis and, since 1986, has been editor-in-chief of the *Journal of the Patent & Trademark Office Society*, an intellectual property law monthly magazine.

**Sidney V. Jackson** in 1988 went through two major changes in his life. In February, he and his spouse became the parents of a baby girl, and then, in August of the same year, he quit his job after 12 years at the Los Alamos National Laboratory and began studying for a Master's of Divinity Degree at the San Francisco Theological Seminary. He hopes to be a Presbyterian Minister in three years. . . . **A. Nihat Berker** has received the TUBITAK Science Award, the highest scientific honor awarded by the Turkish Government. Professor Berker is currently a member of the MIT physics faculty.—**Robert Vegeler**, Secretary, Beers, Mallers, Backs, Salin & Larmore, 2200 Ft. Wayne Ntl. Bank Bldg., Ft. Wayne, IN 46802

It is my sad duty to report the death of our classmate, **Richard H. Willoughby**, who died November 7, 1988. Richard was employed by Bell Communications Research in Red Bank, N.J. . . . Congratulations to **Jacqueline F. Whitney** whose second child, Edward Patrick Siren, was born September 7, 1988. . . . **Richard F. Park** and his wife, Laura, have moved from Silver Spring, Md., to Miami, Fla., where he is now a vice-president in the Trust Department of Sun Bank. He offices one block from the beach at Bal Harbour. He reports that the weather in December is fabulous. He also says: "I'd like my former Senior House compatriots to know that I still safeguard the "Great Seal" of Runkle II.

**Neil Ross** is a cataract specialist along with his wife, Lyn Hauser. They have two boys: Michael, 6, and Benjamin, 5. They opened a Medicare certified surgical center in 1987 so that their patients do not have to go to the hospital for surgery. Dr. Ross is on the board of the Society for Geriatric Ophthalmology and is a project ophthalmologist for the National Eye Institute. . . . **Louise Grochow**, M.D., will have an article published in the upcoming issue of the *National Cancer Institute*. She has two children: Joshua, 5, and Rebecca, 9, and reports: "Married to Jerry ('68) almost 20 years. Wow!"

**Peter A. Stoll** reports: "After years of making an honest living as a design engineer, I've moved to Albuquerque where I am a reliability manager of Intel's newest water fabrication plant. That and three separate intellectual property lawsuits keep me busy." . . . **David Al Leigh** has been promoted to vice-president, marketing of CSPI, a manufacturer of array processors. He maintains contact with the atomic spectroscopy industry where he worked for ten years. My apologies to all of you for missing an issue of class notes.—**Hal Moorman**, Secretary, P.O. Box 1808, Brenham, TX 77833

Had a letter from **Carol Epstein**: "Each year brings bigger and better things. On my birthday, I was promoted to vice-president and director of clinical affairs of Immunex Corp. We are pushing ahead with our recombinant proteins and have some very exciting data to present to the FDA. In addition we are developing some software which will significantly affect the time from patient data entry to submission of report, and therefore the approval time for new drugs. I finally managed to ski Crystal Mountain and it is astounding that there is a mountain of this class within 2 and one half hours of a large metropolitan area (Seattle)." . . . **Conor Reilly** is a partner in the law firm of Gibson, Dunn & Crutcher in New York. He lives in Short Hills, N.J., with his wife Margaret, daughter Kate (5) and son Mike (3). . . . **John Kavazanjian** has moved back to Sudbury from Singapore. He is now vice-president for the communications systems group operations for Data General.

**Michael Cohen** writes that he is "working his way sideways along the corporate ladder. I am now a product manager at Hewlett Packard managing networking software products. I think I've finally found a place with paths I can grow along." . . . **Robert Reiter** reports that, "I've worked the last five years at IBM doing software design for replacing the nation's air traffic control system automation. Praise the Lord. We won the contract—the largest ever for both IBM and the FAA—twice; once by FAA customers' award in July and again by the GSA administrative judge's decision in October. I expect to work the next five years writing the software and making it work." . . . **Farshad Rafii** has been appointed associate professor of management at Babson College. He and his wife live in Wellesley.

Lots to report this month in management con-



sulting. **John Krzywicki** started his own firm in January, Cambridge Strategic Management Group, with 10 employees. "We will concentrate on strategy, market and competitive analysis, and organizational consulting, principally to telecommunications clients." . . . **Elizabeth Hutchins** has "now had my own management consulting business for two years, and all is going very well. My key areas of concentration are information services/data bases and publishing, providing business plans, strategic plans, acquisition analysis, and other consulting services." . . . From Brazil, **Augusto Dias-Carneiro** writes, "One year ago, I started my own consulting company, specializing in management finance and strategy. Emphases are corporate restructuring, mergers and acquisitions, and fine tuning the cash management function. International banks, creditors to Brazil's \$100 billion foreign debt are swapping that debt for equity in healthy local companies. We can help."

**Alfredo Sadun** "recently moved into a larger house within the same suburb of LA (San Marino). I remain as full-time faculty, a professor of ophthalmology and neurosurgery at USC, choosing research and teaching over a more lucrative private practice. Academia brings me extensive international travel and a steady stream of bright proteges who question my every word. I've finished my second book and hope to finish my third next year on sabbatical. Having added Benjamin (1) to the brood (Debra, Rebecca, and Elvis) I remain domestically prolific." . . . **Thomas DiPrete** is an associate professor of sociology at Duke. . . . **Alan Cooper** and his wife Liz are the parents of a son, William James, born last August. . . . **Mark Feldman** is assistant professor of economics at the University of Illinois Champaign-Urbana. . . . **Richard Hawryluk** is a recipient of the American Physical Society Award for Excellence in Plasma Physics Research.—**Dick Fletcher**, Secretary, 135 West St., Braintree, MA 02184

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A few items arrived to brighten up the Virginia winter, the longest of which being a letter from **Dan Dern**: "In addition to six years at Bolt, Beranek, and Newman's network subsidiary as PR manager, I have had success at humorous OpEd writing, my first love. I've become a near-regular in *Information Week* and have been in *Computerworld*, *Datamation*, and other trade pubs these past two years—and had the unlikely but highly rewarding experience of being a substitute dance teacher!"

**Doron Holzer**, manager of Finance Systems for BP America in Cleveland, notes that a trip to Israel last summer was his best vacation ever. . . . **Michael Cheng** now has four in his family: wife Terry, Jason, and Katherine. He is still at IBM as manager of 9751 CBX product planning and business planning groups. . . . **Dennis Tully** has returned from the Middle East with wife Dorene and their offspring, Patrick and Clare, now living in Seattle.

**Gregory Moore** is founding chairman of the new Technology and Intellectual Property Committee of the American Bar Association's business law section. He is with the firm of Ropes and Gray in Boston. . . . **Steve Waller** will have finished two years as an ER physician at Clark AFB, the Philippines, this June. Steve will start an ophthalmology residency in San Antonio on his return, modified rapture after the joy of exploring southeast Asian countries.

On the home front, Eric has finished freshman football and wrestling and is on to baseball. JR has entered Pathways, a special enhancement program for gifted students in our area. Ruth and I will be out in Kansas City the first week of July as the Alexandria Harmonizers defend our international barbershop chorus championship. . . . go for the gold!—**Robert M.O. Sutton, Sr.**, Secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA

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### 15th Reunion

For those of you outside the Boston area, the Harvard Bridge across the Muddy Charles has been under reconstruction for years now and a big topic of discussion recently has been What To Do About The Smoots. Those of us who walked the bridge remember the Smoots were what told us how far we still had to go when it was too cold to look up. One idea the construction contractor has proposed is to put bronze smoot marks right into the new sidewalks. While we're on the subject of reunions, I hope our's is on your short list. We're talking 15 big ones here.

**Janice Gepner** tops the column this month. Janice was the co-recipient of the Award for Excellence in Teaching of Secondary School Chemistry from the Northeastern Section of the American Chemical Society. Janice has been teaching high school chemistry at the Winsor School in Boston since 1981. Thanks for the note. . . . **Marc Richard Lauritsen** says he is now director of lawyering information systems at Harvard Law School. Marc claims he never touched a computer at MIT but says he now conducts research and development on automated legal practice systems for use in poverty law and clinical legal education.

Alumni fund envelopes abound in this month's column. Thank you for your generosity. Marcy and **Tom Wolff**, along with their 3-year-old daughter Ilana, were joined in May by son Joseph Benjamin. Tom writes with news of **Leonard Davis**. Leonard has accepted a position as Staff Research Chemist at Amoco in Naperville, Ill. . . . "I have been a law professor for the last 10 years," writes Neil Cohen, "first at Seton Hall University and now at Brooklyn Law School. Most of my recent work has involved the use of concepts from decision theory in the law of proof." . . . Hello to MacGregor House "A'-entry alumni from **David Fox**. David and spouse Paula Bockenstedt live in Ann Arbor, Mich., and are both on the faculty of the University of Michigan Medical Center. Their third child, Jonathan, was born in December, joining Sharon, 7, and Michelle, 3.

There was an article in the November issue of *Boston* magazine entitled "The New Fogies" with the subtitle: "We haven't become the people our parents warned us about. We have become our parents." Centered in the article about what happened to the youth of the '60s was **Jim Andrew**. Once, Jim supported himself building Bose speaker look-alikes. Now, Jim writes, "I've been developing real estate in Maine the last two years." Jim ends his note with the lament, "I don't like being considered middle aged." Everybody! Repeat along with your humble secretary: "Middle Age is Fifty. Middle Age is Fifty. Middle Age is Fifty . . ." Just ask **Matt Kaufmann**. Writes Matt succinctly, "I'm enjoying life in Austin, Texas."

**Seth Powsner** is keeping busy as a faculty member of the Yale Medical School Psychiatry Department, specifically the Yale New Haven Hospital. Echo cardiology work keeps him in touch with classmate **Larry Siegal**, who's at Michael Reese Hospital in Chicago. . . . "After two years as an independent consultant (knowledge engineer), I am beginning to feel secure in my business," says **Amos Oshrin**. "In addition to consulting, I am now seeking domain experts whose knowledge, captured in an Expert System, may be marketable." How about echo cardiology? . . . Rounding out the column this month is a musical question from **Jack Rich**. "Did I ever write and say I got married?" That was over three years ago he says, to Alice Ain. They are now expecting their first child in June. . . . Tune in again next month for the further adventures of "Smoots Fogie, Award-Winning Legal Baby Psychiatrist."—**Lionel Goulet**, Secretary, 115 Albemarle Rd., Waltham, MA 02154-8133, (617) 899-9694

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Springtime greetings. **Pat Callahan** is still living in the San Francisco Bay area (Marin County) managing operations and systems development at Wells Fargo Bank. Her daughter Katherine is nearly four years old. . . . Writes **Thomas E. McKim**: "The big news for Jane and myself is the birth on July 3, 1988, of our son, William Edward McKim, class of '09. I continue to mix technology with the practice of law at my law firm, Jones, Day, Reavis & Pogue. Litigating over technology and using technology in litigation is a fascinating combination of the two disciplines." (I agree—I do it myself.)

**Robert W. Mann, Jr.** left Pan Am at the end of 1988 to join Carl Icahn and TWA as vice-president, marketing. He's looking forward to taking on more demanding service challenges. His first son, Nicholas, was born on September 1, 1988. Nick and Mom, Susan, are doing nicely.

**William W. Rowe** writes, "Continuing my now long-standing pattern of moving every three or four years, I'm once again exploring a new part of the country (Washington state). The 'trials' of private practice medicine, I've found, are chiefly the trials of dealing with insurance companies and government agencies. It's almost enough to make one welcome a 100 percent government-funded policy. Washington has most of what I want in a home, though—chiefly mountains and snow."

Good to hear from you folks—let's hear from more of you.—**Jennifer Gordon**, Secretary, c/o Pennie & Edmonds, 1155 Avenue of the Americas, New York, NY 10036

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Your secretary's pleas for mail or phone calls for news, alas, has generated a very modest response. Please try to write, fax, or call.

From **Lee Silberman**: "Lucy Russell and I had a relaxing vacation on Captiva Island, Fla. We are now ready for the rigors of the holiday season and another year of working too hard—except Russell, who at 2 is showing definite architectural talent with his blocks. Over Thanksgiving, we hosted a brunch for former ZBTs Rich Barron ('75), **Harry Frischer**, and Richard Smiley ('77), and their wives and children. A membership chairman of the newly active Long Island MIT Club, I wish more local alums would join. We have a great calendar of events scheduled." . . .

**Adam Schnelder** writes that "all is well—at least as well as can be expected when living in New Jersey. I was promoted to partner in the management consulting arm of Touche Ross, mostly working with large financial institutions. Unfortunately, there is significant travel associated with this, despite my best efforts to control it. A recent trip featured Newark, Philadelphia, Pittsburgh, and Dayton, a descent worthy of Dante. The work is fun, nonetheless."

From **Jim Banks**: "I am still working at Hewlett Packard in Silicon Valley, which I joined when I graduated from the Institute. I currently manage an R&D section in Systems Technology, and also manage all corporate-wide Hewlett Packard activities with MIT. I am enjoying sunny California with my wife and daughter."

I have a letter from **Jack Chaney**, whose good correspondence habits I wish more of you would develop. . . . I have a loving wife, two sweet little daughters (1 and 3), and a third child due this May. Have worked with Corning Glass since graduating and currently am supervisor of a group of engineers devoted to design of molten glass delivery systems and support for new meeting process concepts dreamed up by Dan Nolet's ('77) people. Corning has been a progressive and interesting place to work. The Finger Lakes region is beautiful, and I continue to enjoy hiking and bicycling."

As for your secretary, there are never enough



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William R. McClellan  
William Lee, B.S.'71  
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Eugene A. Feher  
Beverly A. Hjorth

Of Counsel  
Alfred R. Johnson, '35  
Joseph Zallen, '39

hours in a day or days in a week. Analyzing, brokering, and trading markets such as bonds, foreign exchange, gold, coffee, cocoa, and sugar is exhausting. Working with my brother on marketing the "Voicebox," our PC-based voice recognition system, is exhausting. Moving into a new house, with its attendant fix-up problems, is exhausting. Running after my daughter is exhausting. The Tute has given me a good background in coping with exhaustion. Please write and tell me how you cope with similar problems. I can't be the only one suffering from exhaustion.—**Arthur J. Carp**, Secretary, Stalco Futures, Inc., 254 West 35th St., 16th Floor, New York, NY 10001, (212) 736-1960, fax: (212) 736-3664

## 77

Sit back, kick off your shoes, and read on about the exciting exploits of your classmates. . . .

**Richard Maebius** graduated from the Duquesne University School of Law in Pittsburgh in June 1988 after going to school at night for four years. He was admitted to the Pennsylvania Bar in November and was also admitted to practice before the U.S. Patent Office last summer. He transferred to the Legal Department of his employer, PPG Industries, as a patent attorney, in January. Richard was pleased to see his old IFC buddy **Dave Dobos** at his graduation ceremonies. Richard had word that **Steve Piet**, '78 and his wife, Robin, are in Idaho Falls. "And now that Jim Bridgare is the 1978 class secretary, we're all relieved to know he's alive and well in Cambridge. (Dave was supposed to be the lifer, remember Jim, not you!)"

**Stephan Greene**, now a northern Virginian like me, has had four addresses in just over five years, "and I'm not even in the military! My wife, Ellen, and I are now happily living in Herndon [Virginia], getting settled into our home. I'm looking forward to meeting other alumni when the MIT Club of D.C. visits the Air and Space Museum's Garber Restoration Facility, a sort of backstage visit! Living near D.C. does have some advantages. Friends from MIT: call if you're in or passing through the area."

**David Doo** has season passes to Disneyland, ostensibly because his daughter Jo-Jo, now 2 (who still gets in free), loves it there. In October, David's family visited with **Bernie Tao's**, '76, family and **Les Feldman**, '76. David advises us all that the MIT Museum presentation of "Legendary Hacks" is a must see. He recommends convincing your local MIT Club to sponsor a showing and then listening to all the alumni in the audience who participated in the hacks give their behind-the-scenes stories. . . . **Deborah Stutman-Brickey** reports that her mega-baby, David, continues to be off the charts for babies his age. She is still working for the Mead Paper Co. in Chillicothe, Ohio, while living in Columbus. . . . **Dan Ludington** reports that his first child, a daughter, Gaia, was born last May 30 at his home in a little village outside of Perpignan, France. He is married to **Odile Corbel**, a French woman he met while studying at the Kushi Institute. "I am officially unemployed," he writes, "but make a few francs picking grapes and cooking for psychotherapeutic massage workshops in Paris."

**Mitchel Kling** has recently been appointed chief of the Unit on Affective Disorders in the Clinical Neuroendocrinology branch of the National Institute of Mental Health in Bethesda, Md. His wife, **Carol Astor**, will be completing fellowship training in pediatric allergy and immunology this summer. They have a daughter, **Lila Rose**, born last March who keeps them thoroughly but happily occupied. . . . **Esther Horwich** and her husband, **Robert Piankian**, recently returned home to Brighton, Mass., from safari in Kenya. Esther reports that it was an incredible journey. "We shot 29 rolls of film in only two weeks. The highlight of the trip was when a bull elephant charged us. (It was the highlight because we escaped.)" She has been nearly nine years in prac-

tice in her own law firm, and she plays bass trombone with the Metropolitan Wind Symphony. . . . **Steven Oblath** has accepted a transfer from Du Pont's Savannah River Laboratory to their Jackson Laboratory in Delaware to work in the quality control labs.

**Carrie Galehouse** married **William Frey** in August 1987. Since he was living in New York and Carrie was in Boston, "one of us had to move." So Carrie left her position as director of sales for Softbridge Microsystems in Cambridge and moved on to become president and chief executive officer of Automated Reasoning Corp. in Roslyn, N.Y. The company designs, builds, and markets a family of artificial intelligence products used for testing and diagnostics of mechanical and electrical systems and equipment. Carrie's nice note shows that she clearly appreciates the rigors of my job—she writes the column in the Harvard alumni magazine for her business school section!

Another good letter came from **Steve Bader** in Newton, Mass. He and his wife, **Angela**, had their first child, **Andrew Ryan**, on July 7, 1988. Angela returned full time to her obstetrical anesthesia position at Brigham & Women's Hospital about two months later. They purchased and significantly renovated a house in Chestnut Hill last year, completing the job right before **Andrew** was born. Steve and a partner purchased the DDS Dental Office in Peabody, and we are glad to hear that it is doing very well. He offers, "All local classmates are welcome for painless dentistry!"

Lastly, I am finding **Brielle** at 6 months to be as pleasant, charming, and alert as her big brother and sister were at that young age. **Joia** and **Kellen** had the thrill of attending the inaugural parade with their dad in January. Did any of you attend any of the inaugural events? Write and tell me about them or anything else that crosses your mind! I'll even accept e-mail addressed to [hertz%cf3.nrl.navy.mil](mailto:hertz%cf3.nrl.navy.mil) on the internet. Can we be the first class to go electronic? Till next time, **Ninamarie Maragioglio**, Secretary, 8459 Yellow Leaf Ct., Springfield, VA 22153

## 78

News from classmates this month came mostly from the tear-offs sent with Alumni Fund donations. It's good to see classmates supporting the Tute, and especially the Class of 1978 Student Aid Fund.

**Renee Roy** and **Bruce Copley** write of a new baby boy—**Javan Winslow Copley**—that they adopted in November. He is almost four months old at this writing, "a smiling, active, challenging addition to our lives." Bruce, Renee, and Javan hope to travel from their home in Shoreview, Minn., to be at Delta Psi's 100th anniversary celebration in May. (Congratulations to those other Delta Psi-classes.)

**Evan Klein** writes from Cathedral City, Calif., "I am now an instructor of data processing at the College of the Desert in Palm Desert (near Palm Springs). Another day in paradise—what can I say?"

**Nayyar Butt** hits the road on his bicycle to find paradise: "I have gotten into biking and really love it. I have biked all over the tri-state area and Canada, and am looking forward to a trip down south this winter." Nayyar is living in White Plains, N.Y.

**Dick Field** writes from Lynn, Mass., "First things first (or third things first)... **Richard Pendleton Field, III**, was born last April to my wife **Donna** and me. Metaphysics folded in February so I helped make a "FRIEND" (at CV) until November when **Donna**, **Dickie** and I jetted off to Rome for a month for my new employer, Novacad. Purpose of the trip: to port the resurrected Metaphysics software to another platform.

From Charlotte, N.C., **Lauren Turkanis** writes, "After waiting months to see photos of the 1978 10th reunion, imagine my disappointment at see-



ing a photo of Harvard B-School crashers titled "Class of 1978." (Harvard knows where to party!) . . . **Mark Pape** writes that he and his wife Diana (Kirshen, SM '82) are kept busy with consulting engineering and with handling two children, Benjamin (18 months), and Jennifer (1 month). Mark and his family are living in Chevy Chase, Md. . . . **Mike Saylor** writes of a new addition to his family, Ian, born in February 1988. Ian's mom is Alison Carmichael Saylor '80. Mike now works at Digital Equipment Corp., in the area of robotic automation. Mike, Alison, and Ian are living in Carlisle, Mass. . . . **Peter Santeusano** was a panelist at the January Boston Enterprise Forum. Peter is a partner at Hambro International Venture Fund, and lives in Winthrop, Mass.

For those of you involved in or considering starting a high tech venture, the Enterprise Forum is a great way to learn about entrepreneurship and to make technical and financial contacts. The Forum exists in a number of cities. Contact your class secretary for more information (and send your news, too).

As you read this, your class secretary will hopefully be getting ready for the lightweight rowing selection camp, training twice a day either on the water or with weights and Harvard stadium tours. The first goal is to be one of the 16 oarsmen invited to July's selection camp. From the 16, the U.S. Lightweight Eight will be selected. Through all this, it really helps to have a caring and patient wife in **Diane Curtis**.

Send your news today! What are YOUR hobbies? **Julie Kozaczka**, Assistant Secretary for Networks; Internet: jstahlhu@hstbme.mit.edu; Compuserve: Julie K. Stahlhut 76566,1012.—**Jim Bidigare**, Secretary, 659 Green St., Cambridge, MA 02139

## 79 10th Reunion

At last, a substantial amount of news to report. With our 10th reunion only a month away, here's your last chance to find out about your classmates before you see them in the flesh.

**Paul Hoffman** wrote in lieu of attending the reunion. He is still writing books, and has just gone over the 250,000 mark for total number of books sold under all his titles. His first main-frame book, *The CMS User's Guide*, was just released and is already selling well. Paul expects to have at least four new titles out this year, all microcomputer books. He had the following comments on life in Berkeley, Calif.: "A fairly high number of ex-MIT types flow through my house, usually for Grateful Dead shows. We don't have enough rain, so there may be a drought, but the up side is that it is sunny in January!"

**Mark Schwartz** has left the Air Force after more than seven years as a fighter pilot flying the F-4 Phantom. He writes, "I am now working for an old Air Force buddy whose family owns Stern's Miracle-Gro Products, Inc., makers of the world's finest water-soluble fertilizers. I am the New England sales manager, as well as quality control manager, co-op program manager, etc. (It's a small company!). The move to Merrick, N.Y., worked out well, as we are back on Long Island, close to both our families. I am going to be flying with a local skywriting company on weekends to keep my hand in aviation. I see **Mark Stern** regularly and look forward to seeing many old friends at the 10th reunion this summer, as I missed the 5th due to military duty. My boy and girl are now 6 and 4, respectively, and keep me busy in my leisure time. I've joined the N.Y. MIT club, but have yet to attend an event! I would love to hear from any old friends who happen to be in the area (516-221-2054)."

**Roy Planalp** has finished his postdoctoral studies at the University of Illinois, and is an assistant professor at the University of New Hampshire with research interests in synthetic inorganic chemistry. . . . **Alan Schauer** is also an assistant professor, but in microbiology at the University of Texas at Austin. Alan and his wife, Nicole West,

welcomed their son, David Alexander Schauer-West, into the family on May 11, 1987.

**Ron Dictor** left General Motors and is now working for Amoco Oil in Naperville, Ill. His observation: "I think I know how the survivors of the Titanic felt!" . . . **Brian Wibecan** writes, "My wife, Nancy Levoy ('81), and I have entered the ranks of parents with the birth of our daughter, Leah Levoy Wibecan, on 8/8/88. She weighed in at 8 lbs., 6 oz., although I had predicted 8 lbs. 8 oz. She is a delightful little girl, and we are all extremely happy. She's got a great birthdate, and coincidentally was born exactly two months after our eighth anniversary." Brian and family live in Wilmington, Del. . . . **Ben Cooper** is a product manager in Graphics Product Marketing with Intel Corp. and lives in Santa Clara, Calif. . . . **David Geiser** is a process engineer at Sverdrup Corp. in St. Louis. He received his MBA from Washington University in St. Louis in May 1987.

**Crawford Smith** writes that he is with Sverdrup Technology in Middlebury Heights, Ohio—is this the same Sverdrup that David Geiser works for? Crawford describes the company as a consulting firm for NASA Lewis Research Center in Cleveland. He is in the area of computational fluid dynamics. He, wife Martha, and two kids Caitlyn and Andrew are enjoying the Cleveland area, except for all the snow! . . . **Bonnie Mason** expressed a similar sentiment. "Al (Chock, '78) and I are still living 'the good life' in New Hampshire. Actually, we're freezing our rear ends off today. Looking forward to seeing everyone at the reunion!" . . . **Dan Goldberger** has joined Doug Johnston ('76) and a third partner to form Square One Technology in Alameda, Calif. to develop medical instruments.

**David John Fillmore** is finishing his residency in diagnostic radiology this July, and will be returning to Boston as a cardiovascular radiology fellow at Massachusetts General Hospital. (I presume from his Tucson address that he is currently at the University of Arizona). . . . **Chris Rose** is still doing research at AT&T Bell Labs in New Jersey. He and his wife are the parents of Stephen, 4, and Evan Michael, 1. "My only complaint is that with a 9-to-5 job, I don't see too much of my kids. Academe, with its more relaxed schedule, is beginning to look more attractive. But the tenure battle and the fight for grants are not so attractive. Well, we shall see what we shall see. Anybody else having these sorts of problems? Maybe we can swap notes!"

**Marvin Chartoff's** old company, Strategies, Inc., merged with Ernst & Whinney last October. He writes, "I've gone from a 50-person telecommunications consulting firm to a 25,000-person audit, tax, and information systems consulting firm. I've lost count of the number of new forms I've had to fill out." Marvin lives in Annandale, Vir. . . .

**Jong-Kie Tjho** reports that he and his wife, Helen, had a baby girl, Stephanie, last December 9. Jong-Kie was a hardware engineer for five years at M/A-COM and Watkins-Johnson Co., both in Maryland, and then spent two years as an international sales engineer for Watkins-Johnson, covering some Asian countries (China, Korea, Japan, Pakistan). Since April 1987, he has been working for ESL Inc. in Sunnyvale, Calif., as a systems engineer. . . . **William G. Swinton** had the following to say: "Hello to all my friends in the class of '79 and the '79 sailing team. Stop by in windy Santa Ana this spring for sailing/windsurfing. I'm in the book."

**Kevin Trammel** and his wife, Denise, are living in Hartford, Conn., where he is the manager of Capacity Planning for Pratt & Whitney overhaul and repair. After graduation, he spent three years with NASA in Houston, then got an MBA from Chicago. . . . **Michael Wax** was married last August to Sandra M. Waters (MBA, Loyola College). . . . **Andrew Weiner** has been at Bell Communications Research in Red Bank, N.J., since getting his Ph.D. in electrical engineering from the Tute in 1984.

Robert and I spent New Year's Eve at the home of our good friends, Arnie and Lori (Ullman)

Herman ('81), in Sharon, Mass. Also joining in the festivities were my former colleague of these pages, Dave Browne ('78), and his wife Yuko, and Ed Moriarty ('75). There were some rumors that **David Soule** was planning to make an appearance, but, alas, they were just rumors. David is back from Toronto, having transferred back to New Jersey with American Cyanamid. Also living in Sharon, with wife Katie and sons Max and Avi, is another ex-class secretary, **Ken Turkewitz**, whom we had the pleasure of seeing that weekend as well. Meanwhile, back here in the Big Apple, Robert and I are halfway through our successful Off-Off-Broadway run of *The Odd Couple*. See you all next month at the 10th you-know-what.—**Sharon Lowenheim**, Secretary, 500 E. 63 St., Apt. 18B, New York, NY 10021

## 81

Hello everybody! It's been another busy month for my mailman. I was happy to receive so many cards and letters. Please continue to keep the U.S. Postal Service in business!

**Jeffrey Lowenstein's** letter came typed on his professional stationary. He says that he completed his dental specialty in orthodontics at New York University College of Dental Medicine last July. His new office is on New York's upper east side, overlooking Central Park. His wife, Robin, is currently a fellow at Columbia-Presbyterian Medical Center and has a private practice limited to pediatric dentistry. In his spare time, Jeff formed an informal organization of young professionals in the New York area and asks interested classmates to contact him at his office at (212) 755-2333 for information. . . . **Dave Summa** left his job of over seven years at Procter and Gamble in Cincinnati for a consulting job with McKinsey in the Second City. Dave and his wife are enjoying Chicago. . . . **Eric Buckman** reports that he is enjoying his work at Lockheed and life in southern California.

**Pam Standley** had a busy year. She was married in May 1988 to William Elwell and moved three months later to Houston from New Orleans. Pam is still working for Exxon and enjoys being a homeowner in a quiet rural neighborhood north of Houston. . . . Fellow Houstonian **Thomas Semple** works for the Chemical Development Department of Shell. Tom moved to the Lone Star state last August after earning his Ph.D. at Brown University and a two-year post doctorate at Yale. Tom says rumor has it that many '81ers will be getting together at **Peter Jernakoff's** wedding this June. Please send a full report and class of '81 group photo! . . . **Victor Miller** continues to work for Loral Electronics Systems as a systems engineer. He is living in the Bronx.

**Laura E. Motes Guthals** and her husband are enjoying their new role as parents since the arrival of daughter Stephanie Ellen on April 27, 1988. Laura has returned to teaching math part time at Brookline High School. Congratulations! . . . **Janice Cohen Chartoff** has been working at the Patent Office in Crystal City, Va., as a patent examiner since last June. She is also attending law school at night to become a patent attorney.

**Bernie Deitrick** was married October 8, 1988, to Joan O'Connor. Bernie and Joan met when they ran in a road race. According to Bernie it was "love at first stride." The Deitricks live, work, and run in Westchester County, N.Y. . . . Keeping pace with Bernie on the marriage circuit is **Wayne Seltzer**, who married Jackie Myland last October 2. Jackie is a speech-language pathologist in private practice. MIT alums attending the party in Boulder, Colo. were **Steve Meltzer**, **Max Klein**, **Rob Schoenberger**, **John Goree**, **Bill Skamarock** (who now also lives in Boulder and is working for the National Center for Atmospheric Research), **Cathy Biber**, **Jeff Kletzky**, **Steven Weiss**, **John Noone**, **Judy Bergwerk**, **Jim Ong**, **Cady Coleman**, and **Julie Foster**. According to Wayne, it was a real Baker reunion. Wayne is currently working for Cadnetix Corp. as a marketing



product manager. He said this is subject to change as his firm is the object of a hostile takeover compliments of Daisy Systems of Mountain View, Calif. Wayne says he likes Colorado too much to move to the Silicon Valley. . . . Silicon Valley may not be right for everyone but it's okay for **Anita Bliss**, who is working for Apple Computer as a manager in R&D.

**Nora Fong**, M.D., has been busy the last couple of years. She did her internship in Los Angeles and has been specializing in ophthalmology in Dallas and New York City. She is also engaged to Charles, an orthopedic specialist in New York. Congratulations. . . . **Julie Neuringer**, M.D., is enjoying her last few months in Dallas before heading home to New England. She is currently a fellow specializing in kidney transplant and will continue her work at the Brigham and Women's Hospital in Boston. . . . News from farthest away came from **Jeremy Barkan**, who is living in Jerusalem, Israel. He claims that there is a good-sized MIT contingent living in Israel. Jeremy is in touch with Shalom (Avery) Lampert ('82) and his wife, Chaya (Cheryl) Walker ('84), who live in Maalot near the northern border with their two children, as well as David Goldfarb ('84) and his wife, Heidi Brun ('84). Jeremy is working in software and hopes to get a Ph.D. in computing.

Thanks to so many of you for writing. Please keep those cards and letters coming. Why not pick up a pen and paper and write to your class secretary today? I look forward to hearing from many more of you.—**Lynn Radlauer Lubell**, Secretary, 216 Beacon St., Boston, MA 02116

## 82

**Alison Kutchins** stopped by our place in Chicago recently on one of her many cross-country flights between San Francisco, where she moved last fall, and New York. She's still a vice-president with Goldman, Sachs. We got to hear all about Alison's trip to Africa last summer.

I also saw some old classmates at a recent dinner for alumni of *The Tech*, including **Richard Epstein** and **Rich Salz** (would have been '82), who both did a lot of skiing last winter, and Dave Shea, '81, who is doing cardiology research at Brigham and Women's Hospital. . . . **Brian Jay Glass** is working at NASA-Ames; his wife, Pat Green, is a law student at Stanford. . . . Turning to the mailbag, **Cynthia Ann Hale** writes that she is working on the integration of alternative powerpicks in the M1A1 main battle tank. . . . **Lori Alperin Resnick** married Mason Resnick, the associate editor of *Modern Photography*, last August. She is working on artificial intelligence research at AT&T Bell Labs in Murray Hill, N.J. . . . **Charles Hobson** is in the second year of a residency in general surgery at the University of Virginia and is doing a research project in lung transplantation. He writes, "I've given up hockey for skiing and electric guitar for electric bass. I still sing, vote Democratic, and am single."

**Dave Medek** reports that he and his wife Pat moved to Arizona in 1985. He is a senior engineer in equipment qualification with the Arizona Nuclear Power Project's Palo Verde Nuclear Generating Station. They own four Arabian horses and don't miss snow at all. . . . **Michael Post** spent six months recuperating after leaving the navy, half as a professional beach bum in Virginia Beach and half as a professional ski bum in Colorado. He's since settled into civilian life as an electric engineer for Westinghouse in Pittsburgh which, according to Michael, is "world renowned for its Auto Eating, 4-Dimensional, Killer Pot Holes."

Drop a line anytime to East Coast correspondent **Linda Schaffir** (18 Prospect Ave., Apt. B-2, Norwalk, CT 06850), West Coast correspondent **Michelle Gabriel** (656 S. Fair Oaks Ave., D-211, Sunnyvale, CA 44086), or me.—**Stephanie Pollock**, 722 W. Roscoe St., No. 204, Chicago, IL 60657

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## 83

**Jeremy Grace** has finally given in and written to Class Notes. Jeremy got his Ph.D. in condensed matter physics from the University of Illinois at Champaign-Urbana in October 1988. Since then, he has been working as a postdoc at the IBM T.J. Watson Research Center in Yorktown Heights, N.Y. . . . Marine Captain **John Roberts** writes from Camp Pendleton, Calif., where he is stationed. John just returned from deployment in the Western Pacific with the Marine medium helicopter squadron. He participated in exercises in Thailand, the Philippines, Australia, Korea, Hong Kong, and Japan. John will be leaving active duty in August 1989 to look for a real job. . . . **Pete Fader** has just finished his third term as an assistant professor of marketing at the Wharton School at the University of Pennsylvania. Pete says he now sympathizes with all the MIT professors that he terrorized during his reign at the 'Tute. Pete has taught several MIT students at Wharton and notes that his wife Mina Park Fader, '85, is one term away from finishing her Wharton MBA. Word has it that Mina did okay in marketing.

I received a newspaper article mentioning **Dan Schwinn**. Dan founded Shiva Corp. with Frank Slaughter, '84, and the two Kappa Sigs raised venture capital and are up and running in Kendall Square. Shiva is developing a line of networking products for Appletalk and IBM compatibles. They estimate 1988 sales will be \$5 million and currently employ 35 people. Congratulations guys! . . . Lastly, I received brief notes on **John Jordan** and **Allan Mathews**. John just completed a master's degree in microwave engineering at UCLA. Allan is a PhD student at Harvard's Kennedy School of Government. . . . Keep those cards and letters coming.—**Jonathan M. Goldstein**, Secretary, 2 Soldiers Field Park, No. 201, Boston, MA 02163

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## 85

**Loren Ann Frost** and **Glen Crawford** have set a tentative wedding date of June 16, 1990. In December Loren finished the required classwork for a Ph.D. in psychology and is looking forward to doing some real research. She is planning to take her qualifying exams this fall and hopes to have the doctorate by '91. Loren and Glen spent New Year's Eve with Charles Goldman ('86) in San Francisco. They also visited friends from French House and New House 5 who are at Stanford and Berkeley.

**Dan Weldman** will marry Susan Gindlin on June 18 in Fairlawn, N.J. Susan graduated from Smith College in 1985. She is now at the University of Chicago pursuing a master's in art history and is working at the Smithsonian. Dan received his MSEE from the University of Maryland in 1986. He is now working at Advanced Technology and Research and pursuing his Ph.D. in electrical engineering at the University of Maryland. They are living in Silver Spring, Md.

**Judy Ko-Wu** and **Fred Wu** have moved to West Hollywood, Calif. Judy is a third-year student at the UCLA School of Medicine. Fred works at the Metropolitan Water District in Los Angeles. Their dog, Pepper, an '85 alumna of Random Hall, is also doing well. All friends are invited to visit them. . . . **Gordon Strong** married **Karla Stickley** in October 1986. He works for TRW as a sub-project manager for systems engineering on a large MIS contract with the Air Force. Karla is a materials engineer with the Air Force Materials Lab. She is a first lieutenant in the Air Force. They bought a new home in April 1988 and hosted a reunion for New Year's (mostly LSC people).

Last July **Roy Peterkofsky** spent two weeks in Europe, mostly in France. In Strassburg he met up with Larry Wang ('84), who is living in Munich. In September Roy did his first (and last) triathlon along with his "coach," **Woody Chin**. In

December he went to Berkeley, Calif., and saw many PKT brothers. The only classmate of the bunch, **Jeff Heglie**, lives in Oakland and does hydrological consulting. Roy still lives in D.C. and works for the Association of American Railroads. . . . **Robert Lezec** is also living in the D.C. area. He is working for Booz, Allen & Hamilton in Bethesda in their survivability practice.

Last April **Lyle Tripp**, **Alan Williams**, **Carlos Ferreira**, **Ed Martin**, **Dan Dobryn**, and **Alex Manchaca** attended FIJI's (Phi Gamma Delta) 100th anniversary reunion. Lyle moved from Oswego, N.Y., to northern California in early '89. Alex is attending Law School at Loyola University, not the University of Chicago as I had previously written. Alex says that our reunion will coincide with Technology Day and Tech Night at the Pops, scheduled for June 7 and 8 in 1990, so start thinking about being in Boston then!

**Inge Gedo** is back in the States! She is stationed in San Antonio, Tex., and expects to be there for a few years. She and her husband just bought a new home. Because it was being built they got to pick everything from the carpet pads to the front door. She is anxious to begin recruiting people to help plan the reunion.

I need to correct a misprint in the December column. David Mondelevitch should be **David Bondevitch**. David was the music editor on the feature film *Hollywood to Deadwood*, which will be released sometime this year through Island Pictures. He is working as a TA for Tom Holman (the chief technician for Lucasfilm) in the Sound Department of the Cinema School at USC. He expects to be graduating after the fall semester. Two other MIT grads at the Cinema School are Mark DeCew, '84, and Bill "Space Epic" Spitzak, '83. Mark is in the same program as David and also works in the Sound Department. Bill just completed his first year in the program. . . . David had dinner with **John Frishkopf** a while back in Boston. John was leaving for a two-week trip to Thailand and Burma, and is working for Citicorp as an investment banking consultant.—**Stephanie Winner** (internet:winner@apple.COM), Secretary, 1026 Live Oak Dr., Santa Clara, CA 95051, (408) 985-6827

## 86

I hope everyone is getting set for summer. **Scott Musinski** is currently a second-year student at the University of Connecticut's School of Medicine. . . . **David Honig** is in his third year of a Ph.D. program at the University of California, Irvine. He is studying computational perception and his thesis is likely to be "Learning to recognize objects from how they move." . . . **James Toh** started working for Booz-Allen & Hamilton in Singapore in 1989. . . . **Douglas Roth** is presently in his third year at NYU's School of Medicine. He is enjoying his general surgery rotation at this time but would rather be sailing on the Charles.

**Rick Feinleib** graduated last October from the University of Arizona with an S.M. in optical sciences. He quickly moved out of Tucson to Columbia, Md., to take a job with System Engineering & Development Corp. (SEDC) as an advanced engineer in optical processing. . . . **Eric Clayberg** worked for two years after graduation for the Wall Street firm of Dillon Read and is now pursuing his M.B.A. from the Harvard Business School. . . . **Liem Mansfield** is in his third year at the Uniform Services University of the Health Sciences, otherwise known as the military medical school. It's a great place to be—everything is free. He doesn't know which specialty he'll end up with but he's looking forward to graduation.

**John Port** has been busy at the University of Illinois, working on completing his M.D.-Ph.D. program in the neurosciences. He completed the National Boards Part One and is now working full time in the lab. He is contemplating marriage to his girlfriend, Dolores. . . . **Grace Tan** attended



a gathering at Adrian Wang's ('85) house in San Jose, Calif., over Thanksgiving. **Penny Fu**, **Greg Harrison**, **Hae Jin Baek**, **Jeff Wang**, **Marco Ambrose**, **Greer Tan** ('87), **George Fan** ('85), **Frankie Law** ('85), and **Leland Mah** ('85) were also there. Penny Fu just bought a condo in Cambridge and Hae Jin, along with Jeff Wang, is studying for an M.B.A. at UCLA.

**Katly Kelly** wrote from Lynnfield, Mass. . . . **Payton James** started grad school last fall in biology in Missouri. . . . **Peter Tatian** is headed to Africa for one year starting in January or February. . . . **Roberta Macklin** finished Boston University and has a house and a job in central Massachusetts. . . . **Chris Raanes** had another awesome New Year's Eve party with a collection of MIT people including a random collection from German house. He and **Jean Moroney** recently returned from a vacation in Vienna. Chris is headed to Maui for some on-the-job telescope trouble shooting. Jean expects to return to Massachusetts from New Mexico permanently in 1989. She's been putting in some heavy-duty time in New Mexico for her Cambridge-based job. . . . **Scott Lawton** continues starting new businesses in the Cambridge area. . . . **Pete McEwen** has announced his engagement. . . . **Ben Costello** was in Africa for a while last fall. . . . **Paul Hermann** is still tooling away in the Berkeley area. . . . **Katly** and **John Sapirstien** are finally in their last year of med school at Boston University. Good luck! . . . **Susan Wittman** is finishing up her master's at Lincoln Lab.

**John Coffee** received his master's in aero/astro from MIT in May 1988 and started working for McDonnell Douglas Helicopter Co. in Mesa, Ariz., in June. He is working on the navigation system for the Advanced Apache attack helicopter. He writes that Arizona is new and different, and the weather is much better than in Cambridge. John spent Christmas vacation visiting relatives in Tacoma, Wash., and visited **Simone Pottenger** in Seattle. Simone is working for Boeing on a project that has her spending every other week in San Jose.

**Philippe Jakimowicz** stayed at MIT over the summer after we graduated in order to finish his second bachelor degree. He then went to Rutgers Graduate School of Management, where he received his M.B.A. in finance last May. He has been working for AT&T in Basking Ridge, N.J., and is engaged to be married in July 1990. . . . **Karl Tucker** had a small get-together recently. Myself, **Matt Phelps**, and Logan Capitan were other MITers in attendance. Matt got married a little while ago and now has two great kids. Of course, we all got to see their pictures. His wife works at TRW in San Bernardino, Calif., close to Norton Air Force Base, where he, Karl, and Logan are stationed. Karl mentioned that **Chris DaCunha** is now at Stanford Business School.

Thanks for all the letters. It makes my job so much easier.—**Mary E. Cox**, Secretary, 1800 Hermosa Ave., #A, Hermosa Beach, CA 90254

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Hi everyone! I hope you all enjoyed a great winter! I bet you're dying to know what your classmates are up to. . . . **Susan McDermott** is working as a process surveillance engineer for the Power Technology Department at the Savannah River Plant in Aiken, S.C. She will soon be a Westinghouse employee at the site. She's been playing soccer with a Columbia, S.C., team and even got some rowing in with the Augusta, Ga., Rowing Club. "The Savannah is a great river for rowing," she writes.

**Michael Hollins** has been using his degree in mechanical engineering wisely. He has been a ski-bear, races giant slalom, and recently had a meeting with Nobel Laureate Oscar Arias in Costa Rica. When time allows, he is a staff member at Los Alamos National Laboratory, where he works with the Proton Storage Ring on their Linear Accelerator. He's also a MIT Educational Counselor

and loves it. . . . **Louis Kuchnir** was awarded a Hertz Foundation PhD Fellowship (one out of the 25 awarded per year) and is using it as a graduate student in the Harvard University Department of Chemistry. . . . **Rovena Sobarzo** is still a graduate student in chemical engineering at John Hopkins and is studying the interactions of mammalian cells with various polymer surfaces using image analysis techniques. She really loves it! . . .

**Corey Kerstetter** is working for his master's at the University of Michigan.

**George Zachary** wrote in to announce Phi Gamma Delta's (Fiji's) 100th anniversary reunion on April 20-23. Other classmates attending include **Rich Rice**, **Gordy Holterman**, **Duncan McCallum**, **Augie Peccei**, **Glenn Hopkins**, **Dave Solo**, **Bob Joy**, **Mike Donahue**, **Art Gregory**, **Steve Brown**, and **Brett Giles**. George quit his job at Strategic Planning Associates in Washington, D.C., and is moving to the south Bay area in California with **Carlos Ferreira** and **Dan Dobryn**. '85. There's a strong possibility that he'll be working at Apple.

**William van Dorne** wrote in to let his classmates know what he is up to. He finished his master's thesis last February along with **Jesper Otterbeck**. William then spent 3 months in Holland where he started his job with the Royal Dutch Shell Co. In July, he moved to Sydney, Australia, (via Thailand) on a four-year assignment, to work in Shell's refinery as a process engineer. Jesper is traveling around the world and will spend some time visiting Australia in March and April. **Tim Jones**, working for Oracle in San Francisco, plans to visit the two in Tahiti sometime in June.

**Greer Tan** was a big help in supplying information for this issue. She's now working at JPL with **Stacey Weinstein** and **Charles Coleman**. Greer was in Boston for the holidays and was in touch with **Rob Swiston** and **Lisa Rockoff**. On the new Student Center at MIT: "It looks awesome! But aren't they getting a little carried away with leather chairs and marble-topped tables?" **Rob Swiston** is working at Oracle with **Jay Cohen**, **Scott Martin**, **Keshauin** and **Canice**. The five of them all share a nice little house in San Carlos. "What a bachelor pad!" They all seem pretty happy. **Chris Young** and **Dan Kennedy** (Boston) are also working for Oracle.

I spoke with **Bill von Novak** on the phone the other day. He is living on Long Island and working for Grumman. He is also contemplating graduate school. Bill is planning a ski trip up north with some old friends; **Gene Cohen** (Boston), **Dave Maes** (Boston), and **Dave Chen** (New York City).

Finally, special congratulations go to **Heejung Koh** and **Andy Wescoat**, '85. They are both living in the Los Angeles area and are planning an August wedding.

That's all I have for now. Thanks again for all your help! Please remember to write me as soon as you have some exciting information you want to share. (It doesn't even have to be that exciting.)—**Stephanie Levin**, Secretary, 41 Prentiss St., Cambridge, MA 02140, (617) 547-6673

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I regret to report the deaths of **Gary Leskowitz** and **Andy Hong** on January 6, 1989. They died in an auto accident in California while driving cross-country. Andy was Course VI-1 and took a year off to work in California. Gary worked on Long Island and was recently engaged. I'm sure I speak for the entire class in expressing our sincere condolences to their families.

**Steve Cohen** is living in Huntsville, Ala. He's working on the laboratory module of the space station and finds it pretty exciting. . . . **Terry Wong** is a business consultant for Oliver, Wyman and Co. He is working in New York City and London. . . . rough life! . . . **Mark Teruolou** is working for Bell Labs in New Jersey and going on many business trips. . . . **Josh Gundersen** is

studying physics at UC/Santa Barbara.

**Frank Chiricosta** finished his first semester of medical school in D.C. at George Washington University School of Medicine. He enjoys it and did well. (Is it possible to enjoy medical school?) He is currently engaged to Tracey Wrightstone, Smith College, '88. Congratulations to you both.

**Scott Kitchen** is attending the graduate school program at Ohio State University in metallurgical engineering. He just started in January. He hopes to be working in electrohydraulic forming. . . . **Roderick Kim** is attending med school at Wayne State University in Detroit, Mich. "He's enjoying himself and tells a lot of interesting anatomical jokes and puns," writes Scott.

**Michelle (Park) Tuveson** is working in Baltimore for Martin Marietta doing anti-submarine warfare work.

**Steve Wasserman** is working at Apple Computers, in Fremont, Calif. . . . **Joseph DiSabato** is working in the Investment Banking Division at Goldman Sachs on Wall Street. He lives in the new Battery Park City and shares an apartment with two other people. . . . **Ernest Prabhakar** is "still riding a skateboard" as he pursues a PhD in physics at Caltech. He believes in "Nerd Pride Forever!"

**James Harrison** is living in Virginia with Eric Andrews, '87, and is working with Sid Banerjee, '87, Erik Gilbert, '84, Lou Martinage, '85, Mark LaRow, '82, Jeff Held, '76, Dave Passmore, '77, Marv Chartoff, '79 and Charley Joyce, '56, for the Network Strategies practice of Ernst and Whinney. They are a recently acquired part of the telecommunications consulting branch of E&W. At the time of writing, he was considering a Christmas-time trip to Germany with **Paul Parfomak**, **Chris Neil** and **Matt Brennan**. It would be great to hear about your travels!

**Louis Roehrs** is working for Apple Computers out in California. He says he enjoys it a great deal, and he may be at MIT recruiting for the company this spring. . . . **Nicole Stucki** is in NYU Law School. . . . **Leann Yee** is busy working for IBM in Boston.

**Julian Marci** went to visit **Craig Jungwirth** in Raleigh, N.C., in late January. They visited UNC-Chapel Hill and found the campus full of activities, but "Chapel Hill doesn't compare to Boston as a college town." Julian has been active in the Catholic Singles of Charlotte. "Since the South is primarily non-Catholic, the group consists mostly of Yankees. I've met many diverse, fun people since joining the group in September." He is also a volunteer in Operation Safeway, a program for runaway teenagers.

**Gail Sadio** is out in Seattle, Wa., working at Boeing Commercial Aircraft. Recently she helped to deliver a baby. A friend of her's was pregnant, so she became the "coach" and found it an amazing experience. Gail is rooming with **Karen Krans**, who also works for Boeing, but the rooming is just temporary, as Karen is engaged to be married to **Curt Croprider** on June 10. Curt is finishing up a master's at the Sloan School and will join Karen in Seattle.

**Doug Chappelle** is also in Seattle working for Boeing and living in his hometown. . . . **Bill Johnson** moved to Seattle with his wife, Cathy, to take a job at Microsoft. . . . **Stephanie Purington** and her husband, Dave, are in St. Louis. Stephanie is working for McDonnell-Douglas.

**Rod Kim** and **Hey Jin Kung** are both in med school. Rod in Michigan, and Hey Jin in Virginia. . . . **Ken DeLeng** and **Paul Anderson** are still in Boston. Ken is at Wang Labs. . . . **Brenan McCarragher** is also in Boston, at Draper Labs. . . . **Anand Mehta** is a grad student at MIT. . . . **Livia Zien** is in her 2nd semester at the University of Maryland, pursuing an MS in electrical engineering.

That's it for this issue. Thanks for all your letters and let's keep them coming! I need your help to make these columns as interesting and informative as possible. Let me know about your summer plans!—**Grace Ma**, Secretary, 435 E. 30th St., New York, NY 10016, (212) 545-7764





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Mr. Russell N. Cox  
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Mr. and Mrs. Michael M. Koerner  
Mr. John and Mrs. Geraldine Kunstader\*  
Mr. Harold B. McInnes  
Mr. William P. Reynolds  
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## 1950

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Mr. Edwin C. Kruse  
Dr. and Mrs. Francis F. Lee  
Mr. and Mrs. Robert W. Mann\*  
Mr. Kenneth H. Olsen\*  
Mr. Lindsay Russell  
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## 1951

Dr. W. Gerald Austen  
Mr. and Dr. David A. Bossen  
Mrs. Joan Goody  
Dr. Marvin Grossman\*  
Mr. and Mrs. Frank E. Heart

Mr. Thomas P. Kelly

Mr. Breene M. Kerr\*  
Dr. and Mrs. Anthony D. Kurtz\*  
Mr. Walter Rajki\*  
Mr. Charles H. Spaulding  
Mr. and Mrs. Albert L. Zesiger

## 1952

Dr. and Mrs. Yaichi Ayukawa\*  
Mr. Alexander L. M. Dingee, Jr.  
Mr. and Mrs. Herbert H. Dow\*  
Mr. Irwin J. Grossman  
Mr. Ernest A. Grunsfeld 3D\*  
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Mr. and Mrs. Joe F. Moore  
Mr. and Mrs. James R. Reese\*

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Mr. and Mrs. James D. Kolb  
Mr. and Mrs. R. P. Simmons  
Mr. Howard S. Stern  
Dr. Martin Wohl\*

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Mr. and Mrs. James J. Baker\*  
Mr. Alex W. Dreyfoos, Jr.\*  
Mr. and Mrs. Paul E. Gray\*  
Mr. and Mrs. Andrew S. Kariotis  
Mr. Ronald A. Kurtz\*

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Mr. Gerald Cohen  
Mr. George P. Edmonds, Jr.\*  
Mr. Jean Montagu\*  
Mr. DuWayne J. Peterson, Jr.  
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## 1956

Mr. C. Gordon Bell  
Mrs. Joseph Gaziano  
Mr. John L. Kelly  
Mrs. Thelma K. Pollard  
Mr. and Mrs. Michael Schiller  
Dr. and Mrs. Andrew J. Viterbi  
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## 1957

Mr. Harry B. Duane\*  
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Dr. and Mrs. Leslie M. Orloff  
Dr. John Psarouthakis  
Ray and Maria Stata  
Mr. Elliot K. Wolk

## 1958

Mr. and Mrs. Joseph J. Gal  
Dr. Robert W. Hausslein  
Mr. and Mrs. James Simons  
Mr. Glenn P. Strehle  
Dr. F. Helmut Weymar\*

## 1959

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Mr. John W. Norris, Jr.  
Dr. and Mrs. James K. Roberge  
Dr. and Mrs. Jorge E. Rodriguez  
Dr. David H. Staelin

## 1961

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Mr. Clement Vaturi

## 1962

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Mr. Edward H. Linde  
Mr. John A. Rollwagen  
Mr. Martin N. Rosen  
Mr. Arthur J. Samberg  
Mr. R. E. Wilhelm

## 1963

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Dr. and Mrs. Ching Chih Chen  
Mr. Lawrence C. Erdmann  
Dr. and Mrs. Thomas P. Gerrity, Jr.  
Mr. and Mrs. James W. Poitras  
Mr. and Mrs. Grant M. Wilson

## 1964

Mr. A. Neil Pappalardo  
Mr. and Mrs. Robert E. Thurber

## 1965

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Dr. and Mrs. Hajime Mitarai  
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Mr. and Mrs. William H. Pike

## 1966

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## 1967

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Mr. Charles Ying\*

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Dr. Robert M. and Mrs. Robyn S. Metcalfe  
Mr. Richard Ying\*

## 1969

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Mr. and Mrs. Robert A. Swanson

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Dr. and Mrs. H. Richard Johnson

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Bryce Prindle  
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Prentiss Lobdell  
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Laurance D. Sibley

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Po T. Ip  
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Sidney Grazi  
Charles A. Piper  
John D. Seaver

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Frederick F. House  
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Richard E. Christie  
H. King Cummings  
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William A. Davis  
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Robert Iredell III  
B. Leonard Krause  
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Rafael J. Martinez  
M. Arnold Wight, Jr.  
William S. Woodward

**1941**  
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George S. Burr  
Joseph E. Dietzgen  
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Joseph H. Myers  
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Caleb S. Taft  
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Robert E. Wentsch  
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Leo Celniker  
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Harry W. Lambe  
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Richard H. Holmberg  
W. Oliver Kincannon, Jr.  
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Harry F. Raab, Jr.  
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Robert S. Gooch  
Robert L. Lord  
Frederick A. Radcliffe  
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Frank H. Thomas III  
D. R. von Recklinghausen  
Harry J. Zimmer

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Richard C. Aquadro  
Clyde N. Baker, Jr.  
Stanley L. Buchin  
Michael J. Cambon  
Nicholas Melissas  
Leonard S. Polaner  
F. Garrett Shanklin  
Donald F. Tarinelli



1953

Harris J. Bixler  
S. Eric Kondi  
Bernard H. Paiewonsky

1954

Morton M. Davis  
Charles H. Goodman  
Thomas J. Henderson  
John C. Kiley  
Peter R. Kuehne  
Richard E. Morley  
Mrs. John N. Pierce  
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Charles L. Riley, Jr.  
Harvey I. Steinberg

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William T. Deibel  
Charles C. Ladd  
Frank Wood, Jr.

1956

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Renato Cervantes  
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William M. Layson  
Dimitri A. Manthos  
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Philip A. Trussell  
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Richard S. Hirschhorn  
Edward L. Hoyt  
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Harry M. Johnson  
Lewis Myers  
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Antonia D. Schuman  
Leonard S. Simon  
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1959

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Bernard S. Levy  
Stewart R. Mott  
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William H. Evers, Jr.  
Jason H. Fane  
Jon D. Gruber  
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Robert A. Dudley '51  
Ronald L. Easley '60  
David H. Frisch '47  
Robert O. Ginaven '66  
Wilfred M. Good '44  
Eugene I. Gordon '57  
T. Marshall Hahn, Jr. '50  
Douglas P. Karo '73  
Benjamin Lax '49  
Paul D. Lazay '69  
J. David Listner '65  
Leonard C. Maier, Jr. '49  
Frederick J. Milford '52  
Kenneth B. Newbound '48  
Norman C. Rasmussen '56  
Allen I. Rubenstein '67  
H. Michael Schulz III '67  
E. Leigh Secrest '51  
Richard B. Stambaugh '41  
Parr A. Tate '53  
Arthur M. Vash '53  
Lawrence G. Votta, Jr. '79  
Robert H. Wertheim '54  
Myron L. Zimmerman '79  
Sidney F. Zimmerman, Jr. '55  
**Political Science**  
William W. Lazarus '84  
Kevin Michael Upton '74  
Jesse L. White, Jr. '79  
**Psychology**  
William F. Ganong '77  
Kwok-Fai So '77  
**Senior Executives Program**  
Howell S. C. Chou '69  
Siegfried K. Hodapp '80  
Paul Neuman '85  
Robert G. Niven '76  
John R. Parry '83  
Robert L. Pennock '73  
Lovett R. Smith, Jr. '57  
David Wilson '67  
**Sloan Fellows Program**  
F. Duane Ackerman '78  
Charles R. Adler '60  
A. Edward Allinson '71  
Robert M. Amick '79  
Robert B. Anderson '66  
Ray W. Ballmer '60  
Richard V. Borzilleri '71  
Robert H. Campbell '78  
Steve Cenko '64  
Wendel W. Cook '68  
John C. Davis '56  
William R. De Long '60  
Earnest W. Deavenport, Jr. '85  
John D. Debbink '56  
Donald A. Dick '68  
Chester W. Diercks, Jr. '62  
Richard E. Disbrow '65  
Webb F. Elkins '83  
James B. Ellis II '80  
James R. Fitzgerald '64  
Reinhard Frank '74  
John H. Gerstenmaier '52  
Walter K. Graham '39  
John O. Grettenberger '73  
Roger W. Hale '79  
Radoy W. Heggland '65  
Donald A. Henriksen '68  
Kenneth F. Holtby '62

Michael S. Holtcamp '74  
James J. Howard III '70  
Joe C. Jones, Sr. '57  
Howard H. Kehrl '60  
Thomas E. Kelly III '83  
George Konkol '54  
Robert L. Kuhn '80  
Marianne Kunschak '83  
Lily K. Lai '83  
Douglas A. Milbury '73  
Irwin D. Miller '66  
Herbert H. Myers '80  
Marlin P. Nelson '57  
Frank Perna, Jr. '70  
R. Anderson Pew '70  
Ralph L. Pickard '66  
John F. Prendiville, Jr. '62  
Wylie S. Robson '56  
Frederick A. Roessle '60  
Carlos A. Salvatori '81  
Richard J. Santagati '79  
Robert E. Scifres '50  
Wilbur H. Sidner '80  
Charles E. Smith '53  
Robert L. Smith '78  
Vinod K. Sood '64  
James I. Spiegel '64  
W. John Swartz '67  
Denis B. Trelewicz '70  
Thomas J. Vincent '68  
Ormand J. Wade '73  
Martha E. Wallace '83  
Robert H. Wallace '54  
Donald H. White '70  
Dennis F. Wilkie '80  
Sam R. Willcoxon '65  
Hugh E. Witt '57  
Willis S. Zeigler, Jr. '66  
**Technology & Policy Program**  
William S. Dunbar CE/79  
Winslow Hayward CE/81  
Richard M. Kutta CE/80  
John C. Stewart CE/80  
**Urban Studies & Planning**  
Peter L. Abeles '58  
Henry G. Brauer '87  
Mary E. Brissette '87  
Anthony W. Caner '85  
Luis Dorich '44  
Alfred Edwards '46  
Samuel M. Ellsworth '55  
James A. Forest '87  
Dennis P. Geoghan '86  
Norman J. Gordon '43  
David M. Gray '85  
Maria D. Hill '86  
Ronald Paul A. Isler '76  
John H. Larson '55  
Judy A. Levenson '76  
Julius S. Levine '60  
Russell C. Lindner '86  
Lawrence Livingston, Jr. '49  
Charles S. Luna '77  
Alan McClennen '47  
Malte Mohr '75  
R. Perry Neilson, Jr. '85  
Donatus C. I. Okpala '77  
Timothy J. Pattison '85  
William Russell-Shapiro '75  
Bernard I. Schachter '85  
Nancyellen H. Seiden '86  
O. Robert Simha '57  
Abbott L. Stillman '73  
**Undesignated**  
Yoshinari Iwamura '74  
Philip A. Le Bar, Jr. '69  
William G. Nemeth '69  
Paola Fano Nisonger '79  
Shobha B. Rao '72  
Ivan R. Sprung '67  
Frank J. Walker, Jr. '69  
**Honorary**  
Joseph S. Collins  
D. Hugh Darden  
Walter L. Milne  
Irene G. Seamans  
1913  
C. Lalor Burdick  
Walter P. Muther  
1916  
Alexander Brest

James M. Ralston  
Wilfred A. Wylde  
1917  
Cornelius C. Coakley  
Lco I. Dana  
Alfred J. Ferretti  
G. Hobart Stebbins  
1918  
Arthur S. Williams  
1919  
Francis A. Weiskittel  
1920  
Percy Bugbee  
Malcolm S. Burroughs  
Henry P. Massey  
1921  
Carole A. Clarke  
Arnold R. Davis  
Philip H. Hatch  
Edward W. Haywood  
Herbert A. Kaufmann  
Myer H. Naigles  
Edward P. Wylde  
1922  
Irving Abrams  
Saul J. Copellman  
Robert F. Cummings  
David H. Harris  
William H. Lang  
Edward J. O'Connor  
Walter M. Saunders, Jr.  
Karl E. Schoenherr  
James B. Spratley  
Eugene V. B. Van Pelt, Jr.  
Samuel I. Zack  
1923  
William P. Allis  
Edward Battey  
Horatio L. Bond  
August A. Buhler  
Charles T. Burke  
Franklin G. Clement  
Bartlett Cocke  
Michael Drazen  
John A. Frank  
Harry Green  
William S. LaLonde, Jr.  
Leander H. Poor  
Joseph H. Scholtz  
Philip H. Vivian  
Archibald Williams, Jr.  
1924  
Everett C. Atwell  
Walter J. Bagby  
Homer S. Davis  
Leo Grossman  
Allen W. Hawkins  
Richard D. Jackson  
Richard Lamborn  
Anthony D. Matarese  
Clarence W. Moore  
Donald E. Moore  
1925  
Alan W. Crowell  
L. Patterson Elliott  
Leroy Foster  
Franklin Fricker  
Maurice B. Frost  
Henry B. Hibbard  
Maxon H. King  
Russell C. Mader  
Russell G. Meyerand  
Alexander J. Rokicki  
Arthur M. Sharp  
Anthony G. Tsongas  
1926  
William W. Farr  
Alfred W. French, Jr.  
John A. Gibson, Jr.  
Thomas D. Green  
Martin L. Grossman  
Howard Humphrey  
Reverdy Johnson  
Henry W. Jones  
Joseph L. Levis  
Albert P. Libbey  
Charles E. McCulloch  
Charles P. McHugh  
Leonard Milano  
Cyril S. Smith

Louis R. Taylor  
Joel S. Tompkins  
George A. West  
1927  
George E. Alfred  
F. Edward Anderson  
Joseph C. Burley  
Elwood A. Church  
Harold J. Creedon  
Walter F. Fathauer  
Lawrence B. Grew  
Herbert G. Johnson  
Gustavo Lobo, Jr.  
C. Wesley Meytrott  
Leroy G. Miller  
George E. Onishi  
Paul E. Parker  
Herbert Parkinson  
Jack B. Peters  
William H. Richards  
Thomas F. Russell  
Harland P. Sisk  
Frank C. Staples  
Robert M. Tucker  
1928  
Harold T. Blackwood  
Henry C. Buntschuh  
Charles S. Carter  
Mariano J. Contreras  
Arthur R. Elliott  
Newton S. Foster  
Elias P. Godreau  
Albert J. Gracia  
John J. Hartz  
Edward H. Holmes  
David Ingle, Jr.  
Arthur C. Josephs  
Ernest H. Knight  
Gerard A. MacGillivray  
Paul J. Martini  
Walter F. H. Mattlage  
John C. Melcher  
John T. Metcalf  
James S. Morse  
David Olken  
Albert J. Puschin  
John K. Rouleau  
Abraham G. Stone  
Hermon S. Swartz  
James E. Ure  
1929  
Ira H. Abbott  
William Baumrucker, Jr.  
Eric A. Bianchi  
Arnold W. Conti  
William E. Creedon  
Paul F. Donahue  
Hymon J. Fine  
Vincent F. Gardner  
Alfred H. Hayes  
Donald S. Hersey  
Malcolm M. Hubbard  
William H. Lerner  
Joaquin J. Llano  
Jonathan F. McCray  
Robert K. Miller  
Almer F. Moore  
Anthony J. Perry  
Hunter Rouse  
Wade H. Shorter, Jr.  
Louis F. Southerland, Jr.  
Thomas H. Speller  
Carlton E. Wood  
1930  
Lawrence B. Anderson  
John F. Bennett  
Elmer R. Burling  
B. Alfred Carideo  
Homer L. Davis, Jr.  
Earl E. Ferguson  
Leonard H. Goodhue, Jr.  
Maurice S. Herbert  
Philetus H. Holt  
Edwin M. Kingsley  
David Landen  
Robert J. F. Lent  
Allan J. McLennan  
Hugh J. Mulvey  
Lionel Pavlo  
Theodore A. Riehl  
Arthur D. Roberts  
Irvine E. Ross, Jr.  
Anthony R. Savina



John J. Scheuren, Jr.  
Alan W. Vint

1931  
Herbert K. Allbright  
Gilbert B. Ayres  
Henry E. Baratta  
C. Randolph Binner  
Charles Broder  
W. Bowman Cutter  
John H. Dodge  
William G. Dodge  
Philip Donely  
Edwin J. Ducayet  
Arthur G. Fuller  
Clement H. Hamblet  
Laurence C. Hicks  
William C. Kay  
Albert L. Kaye  
Addis E. Kocher  
Donald S. Loomis  
George Moy  
William A. Pitbladdo  
Henry D. Randall, Jr.  
Maurice L. Sellers  
Benjamin B. Shulkin  
Albert R. Sims  
H. Sheldon Smith  
John R. Swanton, Jr.  
Charles W. Turner  
Kenneth E. Wischmeyer

1932  
William F. Bannon  
Robert T. Billings  
Edward F. Cahoon  
Melvin Castleman  
Sidney M. Edelstein  
John W. Flatley  
Joseph L. Friedman  
G. Robert Klein  
Guy C. Lentini  
Eugene F. Lynch  
Charles E. McCormack  
Edmund F. McLaughlin  
Jacob Millman  
Robert K. Mueller  
Samuel G. Nordlinger  
Daniel D. Passov  
James G. Ritchey  
Thomas R. Smith  
Charles H. Taylor

1933  
William E. Barbour, Jr.  
Morris C. Beldon  
Charles E. Cashman, Jr.  
George R. Churchill  
Warren S. Daniels  
Robert A. Dobson  
Donald G. Fink  
Thomas K. Fitzpatrick  
Guido M. Garbarino  
Margaret Geddes  
Ivan A. Getting  
Frank F. Gilmore  
Arthur S. Hayden  
Robert Heggie  
George E. Hughes  
Hollinshead T. Martin  
Paul J. Petitmermet  
Henry A. Rahmel  
Frank A. Record  
Stephen H. Rhodes  
Richard Robinson  
Joel B. Stevens, Jr.  
David R. Treadwell  
Julio C. Ulloa  
Warren G. Webster  
Robert H. White  
Beaumont H. Whitton

1934  
Walter W. Bird  
John Godfrey Borger  
Leo A. Carten  
Edgar B. Chiswell  
Elizabeth S. Close  
Roger T. Coffey  
Robert R. Cull  
Kenneth L. Dorman  
Lawrence C. Ebel  
Joseph Fishman  
Robert M. Franklin  
Walton W. Hofmann  
Theodore O. J. Kresser  
E. Philip Kron

Douglas C. MacMillan  
John J. McHugh, Jr.  
Jerry B. Minter II  
Jerome M. Raphael  
Walter F. Read  
Theodore N. Rimbach  
Herbert R. Schwarz  
Frederick Spaney, Jr.  
Theodore Steinberg  
Malcolm S. Stevens  
Bernard N. Stiller  
Albert M. Talbot  
Warren L. Towle  
Philip B. Walker, Jr.  
Carl H. Wilson  
Max Winer  
Walter L. Wise, Jr.

1935  
John H. Anderson  
Bruce R. Bagley  
John B. Ballard  
J. Goffe Benson  
Chester E. Bond  
Lester A. Brooks  
James E. Castle  
Arthur H. Cohen  
Thonet C. Dauphine  
Richard H. Eshbaugh  
Reid Ewing  
Gerhard T. Feyling  
Ellis M. Flink  
Louis B. C. Fong  
Gerald M. Golden  
Frank R. Hatch  
Richard L. Hughes  
Franklin F. Lovering  
George N. Lykos  
Robert C. Madden  
Paul S. Mormino  
Bernard H. Nelson  
Richard L. Shaw  
Robert W. Spinney  
Warren E. Sundstrom  
Frank S. Walters  
Kasmierz J. Winiarski

1936  
Aldo H. Bagnulo  
James G. Baker  
Leonard B. Chandler  
Edward E. Christopher  
George F. Crummey  
Kathleen V. Cummins  
Vincent T. Estabrook  
Lewis Gelbert  
Martin A. Gilman  
Eli A. Grossman  
William A. Healy  
Anton E. Hittl  
Aurelius P. Hornor, Jr.  
Stanley T. Johnson  
Walter K. MacAdam  
August V. Mackro  
Brockway McMillan  
Harold F. Miller  
Roman L. Orzynsky  
James F. Patterson  
Lawrence G. Peterson  
Frank L. Phillips  
Dorian Shainin  
G. Nelson Tower, Jr.  
Roman I. Ulans

1937  
James C. Agnew  
Charles M. Antoni  
William O. Arnold  
E. L. Bartholomew, Jr.  
J. Robert Ferguson, Jr.  
Ernest A. Ferris  
John C. Gibbs  
Robert C. Glancy, Jr.  
Archibald R. Graustein, Jr.  
Daniel J. Hanlon, Jr.  
John J. Hanlon  
Charles F. Healey  
Francis X. Maida  
Norman A. Matthews  
Leon A. Menz  
Gilbert C. Mott  
John B. Nugent  
Thomas A. O'Brien  
Melvin A. Prohl  
Harold E. Prouty  
John C. Robbins, Jr.  
Norman B. Robbins

Robert H. Roethlisberger  
Joseph A. Smedile  
Robert H. Thorson  
Edward F. Tibbetts  
Jervis C. Webb  
Ralph P. Webster, Jr.  
George B. Wemple  
Albert E. Whitcomb  
Duane O. Wood  
G. Richard Young

1938  
Lewis H. Allen, Jr.  
Howard Banzett  
Donald R. E. Barnaby  
David W. Beaman, Jr.  
John S. Bethel, Jr.  
Mead Bradner  
Jeanne K. Buxbaum  
Abbott Byfield  
Dempster Christenson  
Albert M. Clogston  
Russell C. Coile  
John H. Craig  
Arthur S. Dwyer  
Nathan Einis  
Benjamin Epstein  
Lloyd Ewing  
Robert S. Gordon  
Gifford Griffin  
Roy C. Hopgood  
Harold James  
Sumner H. Kalin  
Solomon Kaufman  
Frank B. Kemp  
Lester Kornblith, Jr.  
H. Bruce Leslie  
Ira H. Lohman, Jr.  
Bernard W. Mehren  
Anne S. Mowat  
Enver Muradoglu  
Howard C. Ness  
James P. Pollock  
August T. Rossano, Jr.  
Donald P. Severance  
Cornelius J. Starr  
Harold H. Strauss  
Edgar B. Taft  
David J. Torrans  
Edward K. True  
Frederick J. Viles, Jr.  
Jack T. Wilber  
Vernon C. Winn  
George B. Wood

1939  
George Beesley  
Roger B. Bross  
Philip D. Bush  
Louis S. Castleman  
Richard T. Cella  
Harold Chestnut  
John H. Crankshaw  
George D. Cremer  
B. William De Lia  
Charles F. Freyfogle, Jr.  
Frederick B. Grant  
Walter A. Hargreaves  
Michael V. Herasimchuk  
John I. Herlihy  
Charles F. Hobson, Jr.  
August B. Hunicke, Jr.  
David G. Kaufman  
Burkhart A. Kleinhofer  
Wesley A. Kuhr  
Clinton C. Lawry, Jr.  
Lawrence M. Lyons  
L. Burns Magruder, Jr.  
George P. Morrison  
Walter J. Mykytow  
Irving Peskoe  
W. Hewitt Phillips  
Gordon A. Pope  
Harold W. Pope  
George G. Poulsen  
Robert W. Pratt  
Ryder Pratt  
Burton D. Rudnick  
Paul E. Sandorff  
Frederick F. Schaller, Jr.  
Robert A. Schmucker, Jr.  
Samuel Sensiper  
Vija Sethaput  
Harold F. Snow  
Julian M. Spencer  
Alexander Squire

Winthrop M. Steele  
Robert A. Stone  
Edwin M. Tatman  
G. Woodford Thomas  
Wallace P. Warner  
Irwin K. Weiss  
Charles R. Wieser  
William F. Wingard  
Abraham I. Zimmer

1940  
Martin A. Abkowitz  
Edgar W. Adams, Jr.  
James L. Baird  
Scott Brodie  
Harvey H. Brown  
Roy W. Brown  
M. Arnold Copeland  
Charles Forbes DeMaily  
George J. Dienes  
N. Bruce Duffett  
Richard J. Eberle  
James E. Fifield  
Morris I. Gabel  
David R. Goodman  
Harold Graham  
William H. Hagenbuch  
Donald R. Harper  
Edward G. Hellier  
Walter Helmreich  
Winfield H. James  
Amos E. Joel, Jr.  
George Kaneb  
Joseph K. Knight  
Frederick Lange  
J. Halcombe Laning  
John G. Leschen  
Frank H. Libman  
Joseph F. Libsch  
David F. Lowry  
Marshall D. McCuen  
William C. McDonald  
Richard F. McKay  
Robert G. Millar  
Ralph T. Millet  
Schrade F. Radtke  
Stanley C. Snowdon  
Philip A. Stoddard  
Ralph N. Thompson  
M. Spalding Toon  
John A. Vanderpoel  
L. D. Wheaton  
George M. Wolfe  
Alfred C. Wu

1941  
Zachary P. Abuza  
Robert E. Bailey  
Albert L. Bensusan  
Robert Wallace Blake  
Roger G. Blum  
George B. Boettner  
William T. Butt  
Ralph B. De Lano  
Martin L. Ernst  
William M. Folberth, Jr.  
Franklin Hawkins  
Rudolph W. Hensel  
David Jacobson, Jr.  
Lewis T. Jester, Jr.  
William E. Lamar  
Richard A. Lazarus  
Zhi F. Li  
William E. Lifson  
Robert S. Lundberg  
Newell H. McCuen  
Milton R. McGuire  
Vaughan Morrill, Jr.  
Raymond G. O'Connell  
Harold Radcliffe  
Hilton Sanders  
John F. Sexton  
Robert E. Smith  
John J. Symons

1942  
Arthur W. Avent  
Lawrence E. Beckley  
Charles E. Bossi  
David Christison  
Robert H. Crosby, Jr.  
Luther Davis, Jr.  
Walter S. Eberhard  
Richard X. Gannon  
Robert H. Given  
Robert B. Greene  
Charles S. Hofmann

A. Paul Hotte  
Alan W. Katzenstein  
Warren S. Loud  
Ferdinand Lustwerk  
Alan B. MacNee  
Adrian G. Marcuse  
Claude M. McCord, Jr.  
Carl L. McGinnis  
Joseph R. McHugh  
David B. Nicholson  
Milton M. Platt  
William A. Rote  
Peter P. Sloss  
Edward P. Todd  
Peter G. Volanakis  
Carl Zeitz

1943  
George W. Bartlett  
Arthur O. Black, Jr.  
Frank E. Briber, Jr.  
Bernard Brindis  
Frank A. Claudon  
Frank B. Dibble  
Charles A. Duboc  
Thomas K. Dyer  
George Feick III  
John M. Fiore  
William G. Franklin  
Howard S. Gleason  
Ward J. Haas  
Stewart M. Hill  
James F. Hoey, Jr.  
Richard F. Jouannet  
Wilfred Kaneb  
William R. Kittredge  
Charles J. Lawson, Jr.  
Hung Liang  
T. Kemp Maples  
James O. McDonough  
John M. Miller  
Thomas A. Mitchell, Jr.  
Hugh Parker  
Robert L. Rorschach  
William L. Sammons  
Siddhi Savetsila  
F. Curtis Smith  
Morton F. Spears  
D. Read Stevens, Jr.  
Herbert G. Twaddle  
William A. Verrochi  
Michael Witunski

1944  
F. Joseph Amrhein, Jr.  
James L. Baker  
Ralph A. Barrows  
Norman Beecher  
Robert E. Benedict  
Warren A. Bishop  
Henry N. Bowes  
John H. Burdakin  
Robert M. Byrne  
Herbert L. Carpenter, Jr.  
Andrew Chaplin  
Frank K. Chin  
Robert M. Copsey  
E. H. Cumpston  
Louis R. Demarkles  
Bernard J. Duffy, Jr.  
John E. Egbert  
James M. Gassaway II  
Arthur Gray, Jr.  
Norman L. Greenman  
Holton E. Harris  
Richard H. Hinchcliff  
William R. Hopkins  
Robert V. Horrigan  
Warren H. Howard  
Austin T. Hunt, Jr.  
William A. Jack  
Walter A. Jaeger  
John H. Kellogg, Jr.  
Martin King  
Herbert F. Knappe  
Gilbert K. Kruee  
Lorenzo A. Lamadrid  
Samuel H. Lampert  
Han Tang Liu  
Henry A. Lurie  
John W. Matthews  
Kenneth W. Nelson  
Robert Oppenlander  
E. Alfred Picardi  
C. Spencer Powell  
William S. Richardson

George S. Saulnier  
Andrew J. Schmitz, Jr.  
Norman I. Sebell  
Joseph Shrier  
Leland F. Stanley  
Robert V. Thiede  
Page S. Ufford, Jr.  
John Upton, Jr.  
Chester L. Woodworth  
John Woolston  
William A. Wynot

1945  
John O. Atwood  
James M. Barrabee  
Walter E. Borden III  
George R. Brothers, Jr.  
Ralph P. Cromer  
Guy W. Gilleland, Jr.  
Charles H. Hart III  
Sing Leong  
Andrew A. Marocchi  
William G. Martin, Jr.  
Thomas J. McNamara  
William J. Meade, Jr.  
Arthur E. Miller  
Warren H. Miller  
Nicholas V. S. Mumford, Jr.  
William H. Pasfield  
David O. Richards  
Eugene S. Rubin  
Max E. Ruehrmund, Jr.  
Luigi J. Russo  
Robert K. Schumacher  
Clinton H. Springer  
Edward Stoltz, Jr.  
Donald P. Strang  
Harold Thorkelsen

1946  
Richard M. Adler  
Lyal D. Asay  
Louis B. Barber  
Edward L. Belcher  
Raymond E. Benenson  
Lawrence G. Body  
Sterling S. Bushnell  
William J. Casey III  
Daniel I. Cooper  
James S. Craig  
M. Louise Curley  
Thomas J. Donnelly  
Stanley T. Droski  
John S. Filbert, Jr.  
James A. Finney, Jr.  
Alexander E. Halberstadt, Jr.  
Sigurdur G. Halldorsson  
Ernest G. Jaworski  
Mason I. Lappin  
David R. Longmire  
Robert H. Marks  
Alexander W. Mc Ewan  
James S. Murphy  
Barbara Murray  
William H. Peake  
Charles E. Peck  
William H. Peirce  
James C. Ray  
Arthur Schiff  
Edmund W. Sellman  
Richard J. Steele  
Warren H. Turner

1947  
Robert F. Athow  
John E. Bartelt  
Thomas H. Bay  
Harold E. Burton  
Peter Callejas  
William J. Crawford III  
Robert N. Creek  
Steffen F. Dieckmann  
Walter R. Ericsson  
Carl E. Eyman, Jr.  
Rufus M. Franklin  
David H. Frantz, Jr.  
Wilfred L. Freyberger  
Virginia I. C. Grammer  
Quentin D. Groves  
Raymond W. Hasse, Jr.  
Theodore B. Hogg, Jr.  
John G. Holmes  
Charles W. Hoover, Jr.  
Frederick H. Howell  
Leland F. Johnson, Jr.  
Martin B. Judge



Arnold S. Judson  
John S. W. Kellett  
Edward C. Kistner, Jr.  
Kenneth A. Marshall  
John C. Martin  
John E. Maxfield  
W. Robert Melville, Jr.  
Leslie C. Merrill  
John J. Murphy  
Gilbert S. Parker  
Alexis Pastuhov  
Willis B. Reals  
Joseph J. Riley  
Richard A. Scheuing  
Martin D. Schwartz  
Harry Sherman, Jr.  
William R. Smith-Vaniz  
Ferdinand S. Veith  
Howard A. Zwemer

**1948**  
Stanley Abkowitz  
Eugene Ashley  
Fred C. Bailey  
Marshall E. Baker  
William Bangser, Jr.  
Jack Baring  
Richard V. Baum  
William H. Bertolet III  
S. Martin Billett  
John G. B. Booth  
Kenneth C. Bushway  
Thomas J. Cahill  
Albert F. Carr  
Cassius M. Clay  
George F. Clifford, Jr.  
William N. Coffey  
Richard J. Conlan, Jr.  
Robert Crane  
Bernard P. Devins  
Nicholas Dewolf  
George S. Dundon  
Stanford A. Fingerhood  
Aldo F. Fioravanti  
John L. French  
Robert S. Friedman  
Edward S. Frohling  
Edward E. Gardner  
Curtis S. Green  
Alden F. Greenlaw  
Peter A. Guercio  
Elton F. Hammond, Jr.  
Robert W. Hanpeter  
Geraldine M. Haughey  
John W. Hawkins  
Edwin E. Hebb, Jr.  
E. Neil Helmers  
John C. Henderson  
Robert O. Hirsch  
William N. Hosley  
Frank J. Iskra  
Frank E. Jamerson  
Donald Jenkins, Jr.  
Robert H. Jenkins  
Harry G. Jones  
William J. Joyce  
Benjamin F. Kendig  
Harry L. Kopp  
Edward J. Kratovil  
Philip M. Lally  
Irwin L. Lebow  
James Leon  
Daniel I. Levin  
Charles W. Loufek, Jr.  
Franklin E. Mange  
Lawrence R. Manoni  
James E. Manson  
Bonni P. Martinez  
Manuel L. Matnick  
Erik L. Mollo-Christensen  
John C. Moore  
John D. Morrison  
Robert R. Mott  
Alfred J. Murrer  
John E. Nicholson  
Donald W. Noble  
Julian F. Pathe  
Thomas E. Pawel  
Donald M. Perkins  
Gordon H. Pettengill  
Thomas H. Pigford  
William R. Porter  
William J. Riordan  
Gilbert V. Rohleder  
Carlton J. Rohrer  
Jay S. Salz  
William B. Schmidt  
William M. Shempp  
Arnold M. Singer

Alvin J. Siteman  
Arnold H. Smith  
Earl K. Solenberger  
Leonard J. Stutman  
Julian D. Taub  
Robert E. Turkington  
David W. Vigoda  
John M. D. Walch  
Henry Warner  
Otto K. Wetzel, Jr.  
Harvey B. Willard  
Robert A. Wofsey  
Backman Wong  
George A. Wood, Jr.  
Haig S. Yardumian

**1949**  
John R. M. Alger  
Angelo R. Arena  
Robert A. Arrison, Jr.  
John W. Barriger IV  
Orlien N. Becker  
Paul S. Bercoe  
Robert O. Bigelow  
Anatol W. Bigus  
Frederick I. Brown, Jr.  
Elda Chisholm  
Norman A. Chrisman, Jr.  
Leslie W. Cline, Jr.  
Gary S. Colton  
Stanley S. Davies  
Thomas J. Devine  
William S. Edgerly  
John Fairfield, Jr.  
Guilford W. Forbes  
William A. Forsyth, Jr.  
Donald L. Gillespie  
John W. Goppelt  
A. Neale Gordon  
Ronald L. Greene  
Robert S. Griggs  
O. Summers Hagerman, Jr.  
Frank B. Harris, Jr.  
Howard E. Hendershott, Jr.  
Thomas L. Hilton  
Charles K. Holmes, Jr.  
David R. Israel  
David B. Kellom  
Alfred F. Kenrick  
Edward M. Kerwin, Jr.  
Otto E. Kirchner, Jr.  
John A. Knowlton, Jr.  
Malcolm H. Kurth  
Thomas J. Lamphier  
Richard E. Lang  
Ray E. Larson  
Albert A. Levingston  
William S. Lewis  
Demetre P. Ligor  
Raymond A. Lindstedt  
George P. Loomis  
William J. Lueckel, Jr.  
Robert F. Mahar  
Stanley V. Margolin  
Robert L. McConaughy  
Gregor F. Meyer  
William C. Mitchell  
Richard D. Morel  
Paul B. Ostergaard  
Chester M. Patterson, Jr.  
Lewis H. Roosa  
Robert H. Ruth  
John R. Saxe  
William C. Schneider  
Richard J. Scully  
Herbert L. Spivack  
Robert F. Steinhart  
David Tod  
J. Thomas Toohy  
Vernon P. Turnburke, Jr.  
Charles M. Walker  
William F. Wicks  
Eugene E. Woodward  
E. Zapata H.  
Marvin D. Zimmerman

**1950**  
David D. Adams  
Peter B. Baker  
George A. Basta, Jr.  
Norton Belknap  
Herbert D. Benington  
Lowell S. Bensky  
Anne C. Bickford  
John H. Bickford  
Howard P. Bill  
Donald R. Bresky  
Richard C. Brogle  
Thomas C. Buchanan III

Cosimo L. Cataldi  
Robert A. Cesari  
Norman B. Champ, Jr.  
Warren F. Clement  
Edward S. Cohen  
John W. Craig, Jr.  
A. John Esserian  
J. Haroldo Falcao  
James M. Fitzpatrick, Jr.  
Harry G. Foden  
Alfred J. Gallucci  
James W. Geiser  
Sebastian J. Gianni  
Richard A. Gnecco  
Robert F. Gordon  
Frederic D. Grant  
Malcolm Green  
Donald A. Harnsberger  
Herbert L. Hochberg  
James A. Hooper  
Edward H. Jacobsen, Jr.  
Carroll I. Johnson  
Thomas F. Kaveney  
W. John Kocher, Jr.  
John S. Lane  
John B. Lawson  
Gerald A. Lessells  
John H. MacMillan  
Stanley Martin, Jr.  
John T. McKenna  
Jonas Medney  
Edwin B. Miller  
Raymond M. Moeller  
William E. Mooz  
William Murphy, Jr.  
William B. Nichols  
Will F. Nicholson, Jr.  
Paul F. Pearce  
Philip K. Pearson, Jr.  
Alfred M. Petrofsky  
Robert L. Plouffe  
Richard R. Potts  
Richard P. Price  
Milton L. Rand  
Herbert A. Ridgway  
Mariano A. Romaguera  
Thomas E. Shepherd, Jr.  
Vinson Simpson  
John A. Smith  
Karol A. Stark  
Edward R. Stover  
Dan R. Test  
Constantine T. Tsitsera  
Paul B. West  
Robert E. Wilson

**1951**  
Raymond D. Atchley  
John H. Bergmann  
Christian C. Bolta  
Edward L. Bronsten, Jr.  
Frederick J. Bumpus  
David I. Caplan  
William J. Cavanaugh  
John F. Dennis  
William H. Dodrill  
Jerome I. Elkind  
Charles W. Ellis III  
Allan Elston  
Frederick D. Ezekiel  
Richard R. Fidler  
David Findlay  
Thomas E. Ford  
Richard L. Foster  
David A. Grossman  
Lawrence W. Hitchins  
Rodney G. Huppi  
Karl Kniel  
Hubert E. Knipmeyer  
J. Franklin Koehler  
L. Keith Koehler  
George L. Larse  
Frederick G. Lehmann  
Robert A. Lindquist  
John C. Lowry  
James K. McCauley  
Robert G. Norton  
Alfred P. Olivera  
Charles A. Orne, Jr.  
John F. Pasioka  
William D. Pinkham, Jr.  
James A. Pitcock  
Lester W. Preston, Jr.  
John S. Prigge, Jr.  
William G. Rhoads  
Jay Rosenfield  
Samuel Rubinovitz  
George E. Schultz  
Frederick Segal

Joseph N. Sherrill, Jr.  
Harold Aryai Siegel  
Howard E. Simmons, Jr.  
Lester M. Slocum, Jr.  
Paul G. Smith  
Anthony Stathoplos  
Richard Strauss  
Richard M. Towill  
Herbert B. Voelcker, Jr.  
Frederick W. Weitz  
Bernard Widrow  
I. Victor Yancey

**1952**  
Arthur I. Auer  
Charles G. Beaudette  
John C. Berlinguet, Jr.  
C. William Carson  
Bock M. Chin  
David H. Curry, Sr.  
Robert H. Damon  
Milton S. Dietz  
James Dorsey  
Howard H. Fawcett  
Daniel E. Finger  
Alan S. Geisler  
Herbert Glantz  
Jackie H. Guthrie  
Nicholas J. Haritatos  
Joshua Y. Hayase  
Richard E. Heitman  
Clifford H. Heselton  
Richard F. Jenney  
Paul R. Johannessen  
Sanford A. Kaplan  
James K. Knowles  
Harry S. Kradjian  
Arnold G. Kramer  
Richard E. Lacey  
William H. Lane  
Jack Larks  
Herbert C. Lebovitz  
Michael D. Lubin  
Daniel H. Lufkin  
Robert M. Lurie  
Paul A. Lux  
Richard E. Lyle  
Edward K. Matthews  
Michael Nacey  
Kevork V. Nahabedian  
Robert H. Norton  
Ralph E. Raynard, Jr.  
John B. Savoca  
Clifford M. Sayre, Jr.  
Stanley J. Solomon  
H. Stephen Spacil  
James S. Stolley  
James R. Strawn  
Stanley H. Sydney  
Arthur S. Turner  
Emil J. Volcheck, Jr.  
Seymour S. Weintraub  
David W. Weiss  
Andreas Wessel  
Frank T. Wheby

**1953**  
Ralph D. Anglin  
Joseph B. Banks  
David M. Berg  
E. Fred Brecher  
John R. Ehrenfeld  
Jesse D. Erickson  
Morton J. Friedenthal  
Alan L. Friedman  
Gilbert D. Gardner  
Kent F. Hansen  
George B. Hegeman  
Lionel L. Kinney  
David L. Klepper  
Richard I. Linde  
Richard S. Lindstrom  
Robert P. McDonald  
John P. Medgyes  
Douglas L. Meyer  
George J. Michel, Jr.  
Joan F. Mizer  
John C. Morgenstern  
Joseph F. Mullen  
William S. Nagel  
Robert R. Piper  
Burton M. Rothleder  
Wilson H. Rownd  
Stanley J. Sadowski  
Eric G. Schwarz  
Paul P. Shepherd  
Willard B. Spring  
Robert L. Tessier  
Maurice L. Torti, Jr.

G. Harold Tseklenis  
Tolyn J. Twitchell  
Jon Van Winkle  
James A. Zurbrigen  
**1954**  
Gordon Aitken  
Barbara B. Black  
John Blair  
Wallace P. Boquist  
Frederick H. Bowis  
Michael B. Boylan  
Donald L. Cassidy  
Jerome Catz  
Donald M. Dix  
William J. Eccles  
Wilbur P. Fiske  
Camillo A. Ghiron  
Philip Gilbert  
Donald T. Goldberg  
John H. Gusmer  
Arthur W. Haines  
Frederick L. Hofmann  
Dean L. Jacoby  
James E. Klapmeier  
Samuel J. Losh  
Louis E. Mahoney III  
Kenneth S. Marks  
Richard G. McKee  
Aristides Miliotis  
Avrom A. Mintz  
Emmanuel J. Otis  
George L. Perry  
Jerry L. Perry  
John M. Peterson  
Francis J. Ryan  
William H. Ryer  
Philip R. Sayre  
Allen M. Schultz  
George G. Schwenk  
Oscar W. Sepp, Jr.  
Marilyn L. Shilkoff  
Charles M. Smith  
David F. Springsteen  
Robert W. Stewart, Jr.  
James R. Stuart  
Robert J. Sukenik  
George M. Thurlow  
David B. Whelpley  
Stanley Wolk  
Klaus M. Zwilsky

**1955**  
Paul H. Attridge  
Richard I. Bergman  
Robert F. Buntschuh  
Edwin A. Chandross  
Zaven A. Dadekian  
Alan S. Dana, Jr.  
Gilbert Davidson  
F. Eugene Davis IV  
Joyce P. Davis  
Robert G. Dettmer  
James H. Eacker  
Philip N. Eisner  
Eduardo L. Elizondo  
Robert P. Greene  
Michael E. Halpern  
John F. Hayes  
G. A. Herrera Y. Fernandez  
John T. Kennaday  
Warren H. Lattof  
Gordon R. Lohman  
Stephen B. Loring  
Gerald P. Maloney  
Wayne C. McClung  
Sheldon H. Moll  
Richard D. Nordlof  
Sidney J. S. Parry  
Frank E. Perkins  
George Ploussios  
Charles T. Prewitt  
Karl A. A. Reuther  
Charles S. Robertson, Jr.  
Gregory L. Robillard  
Randall S. Robinson  
Walter Rubin  
Walter G. Shifrin  
Ashton C. Stocker  
James A. Stone  
John R. Stopfel  
Allen G. Tarbox, Jr.  
R. Peter Toohy  
Allen H. Wahlberg  
John F. Wing

**1956**  
Mohammad M. Akhavein  
Victor J. Bauer  
Howard S. Bertain

Bruce B. Bredehoff  
Arnold P. Breeden  
Paul E. Brown  
John A. Buell, Jr.  
Richard N. Carlson  
Paul S. Cianci  
Ronald C. Clark  
Stephen N. Cohen  
William R. Dickson  
Irwin Dorros  
Arthur Frank  
Stuart Frank  
Walter P. Frey  
Samuel S. Friedman  
Gideon I. Gartner  
Larry R. Goldberg  
William S. Grinker  
Joel A. Hamilton  
Robert J. Hochman  
Charles P. Hoult  
Gordon Kane  
David L. Kaufman  
Robert L. Kissner  
Charles L. Kusik  
Paul H. Luckett III  
Richard I. Mateles  
Edward K. Moll  
John D. Mueller  
Joseph P. Neville  
Anthony Praznik  
Wendyl A. Reis, Jr.  
Bernhard W. Romberg  
Axel E. Rosenblad  
Jesse Rothstein  
Robert F. Santos  
Robert N. Sawyer  
Gottfried T. Schappert  
Regis W. Schultiss, Jr.  
John A. Seeger  
Richard E. Skavdahl  
Walter R. Sooy  
Philip Spertus  
Lindley S. Squires  
John D. Stelling  
James O. Stenborg  
Howard A. Trachtenberg  
Stuart Z. Uram  
Paul Hermann L. Walter  
Joseph L. Wauters, Jr.  
Elwood S. Wood III  
Stanley T. Wray, Jr.  
Thomas Yonker  
Francis H. Zenie

**1957**  
Paul G. Adler  
Paul R. Ammann  
Richard L. Baird  
Arthur E. Bergles  
Andrew S. Blackman  
Bruce Blanchard  
Richard W. H. Bohlen  
Alan S. Borstein  
Richard D. Brandes  
Joseph J. Carty, Jr.  
Howard I. Cohen  
Bernard R. Cooper  
Stewart M. Crawford  
John B. Crews  
John A. Currie  
William H. Doughty  
Henry Eder Caicedo  
Ronald E. Enstrom  
Martin L. Gerson  
A. Dickson Hause  
Robert J. Hull  
Patrick B. Hutchings, Jr.  
Frederick L. Jaggi  
Malcolm M. Jones  
Graham Lusk  
Donald C. MacLellan  
Richard M. McCabe  
Terrence K. McMahon  
Richard R. Monsen  
Frank E. Murphy, Jr.  
Ross W. Newsome, Jr.  
Donald A. Norman  
Eliot J. Pearlman  
Silvester Pomponi  
Ralph C. Reynolds  
John J. Rinde  
Robert H. Rosenbaum  
Jared J. Safirstein  
Henry E. Salzhauser  
Herbert F. Schwartz  
James G. Simmonds  
Ira Skelet  
Richard D. Smallwood  
Harold P. Smith, Jr.



Robert M. Sterrett II  
Paul James Stoll  
Erwin H. Straehley  
Lavette C. Teague  
William B. Thompson  
Francisco R. Villanueva  
William R. Walsh  
Stephen Weisskoff  
Robert C. West  
Richard V. Westerhoff  
Benjamin J. Woznick, Jr.

David F. Pawliger  
Adul Pinsuvana  
Joseph P. Seidel  
Oliver E. Seikel  
Louis P. Sileo  
J. Richard Swenson  
Daniel I. Wang  
Jonathan B. Weisbuch  
Stephen K. Whittemore  
Marie M. Wray  
James W. Ying

# 1958

Arnold E. Amstutz  
Hillel J. Auerbach  
Robert L. Baber  
Roger D. Baggenstoss  
James G. Barber  
William A. Bayer  
Edwin C. Bell  
David A. Berg  
Michael E. Brose  
Sheldon W. Buck  
Joseph T. Burval  
Stephen Corman  
Raymond H. Danon  
Elisabeth M. Drake  
Dale N. Dukes  
Michael A. Falk  
John F. Fallon  
Burton D. Figler  
I. Howard Fine  
Richard A. Finn  
Fred Fisher  
John B. Forrest, Jr.  
John T. Frankie  
O. Michael Gordon  
Stephanos S. Hadjiyannis  
William R. Hauke, Jr.  
Alfred G. Hortmann  
Richard H. Hough  
Dana Huestis  
John C. Ingraham  
Robert D. Jones  
Kenneth H. Langley  
Paul R. Larson  
King M. Lee  
John H. Leigh  
Hugh J. Murphy  
Martin J. O'Donnell  
Robert E. Oleksiak  
F. W. Ostermayer, Jr.  
Allen R. Philippe  
Theodore M. Quist  
David J. Rachofsky  
Robert M. Rose  
Paul H. Rothschild  
John M. Seavey  
Louis B. Seigle  
Merrill Sidman  
Roy F. Thorpe  
Edward Wanger  
John R. Yearsley  
Howard G. Ziff  
Arthur L. Zimmert  
Bazil R. Zingali

Ronald D. Agronin  
Jon Anthony Aldrich  
Phillip B. Allen  
Paul F. Berg  
Peter B. Brandt  
Edward A. Bulanowski  
Ronald M. Burde  
John H. Connell  
Abe Feinberg  
Charles J. Garbarini  
David H. Geisler  
Joseph I. Goldstein  
Standley H. Goodwin  
Robert N. Gurnitz  
Kenneth E. Hagen  
Stephen E. Halprin  
Charles H. Haspel  
Joel Hirschel  
Gerald H. Kaiz  
Donald A. King  
Deena A. Koniver  
George P. Koo  
Calvin S. Koonce  
Morris J. Kriger  
Andrew Larsen, Jr.  
Robert E. Lienhard  
Larry R. Martin  
John S. Maulbetsch  
Edward O. McCartney  
Richard L. McDowell  
Kenneth R. Myers  
Richard H. Oeler  
Harold J. Parmelee  
Edward R. Pollard, Jr.  
William M. Robertson  
Howard L. Rosenthal  
M. Elizabeth Schumacker  
William C. L. Shih  
Anton Simson  
Robert S. Troth  
Leonard B. Vaughn  
Daniel E. Whitney  
Raymond G. Wilkins

# 1961

John W. Baxter  
John S. Benjamin  
Gary W. Bickel  
John H. Bousman  
Mitchell B. Brodtkin  
Alan H. Cohen  
Joseph T. Davis  
John M. Deutch  
Robert J. Dulsky  
Dorsey C. Dunn  
Donald D. Easson  
John M. Ellis  
Reed H. Freeman  
Thomas L. Geers  
George W. Gladfelter  
Peter R. Gray  
William C. Grimmell  
Grady W. Harris  
G. Charter Harrison III  
Thomas N. Hastings  
Lawrence A. Horowitz  
Robert S. Kaplan  
John N. Kogan  
John G. Layter  
Joseph A. Lestyk  
Richard F. McKay  
Robert S. Mroczkowski  
Thomas P. Nosek  
Michael J. O'Neill  
Richard F. Otte  
Leslie C. Patron  
Gerald E. Pollon  
Richard J. Resch  
David A. Roberts  
Philip J. Robinson  
Bradley C. Ross  
Charles L. Ruttenberg  
J. Curtis Shambaugh  
Mannie Smith  
Nelson E. Stefany  
Edward H. Strachan

John J. Sullivan  
Edward L. Tucker  
Peter Ver Plank  
John A. Vlcek  
Robert F. Weimer  
Samuel J. Williamson

# 1962

Jerry L. Adams  
Jose R. Alonso  
Robert E. Anderson  
Lloyd Armstrong, Jr.  
Alfred H. Bellows  
William D. Bloebaum, Jr.  
Robert T. Brady  
William T. Bray  
Peter Brown  
Vito A. Caravito  
Alan L. Citron  
James B. Cliffora, Jr.  
Arthur R. Cooke  
Philip D. Cunningham  
George S. Dotson  
James Stark Draper  
Dean E. Eastman  
Edward A. Feustel  
Barry J. Fidelman  
Donald C. Fraser  
William J. Fry  
Albert F. Gleim  
William K. Goetz  
Jeremy R. Goldberg  
Theodore C. Goldsmith  
Gerald L. Gottlieb  
Sherwin Greenblatt  
Rurik B. Halaby  
Stephen R. Helpert  
Richard L. Horttor  
Sang-Hak Hwang  
Joel A. Karp  
Dwight A. Kellogg  
James D. Miller  
Robert A. Morris  
Robert F. Morse  
Martin C. Poppe, Jr.  
Stephen C. Root  
Darold W. Rorabacher  
Earl R. Ruiter  
Judith E. Selvidge  
Peter R. Shrier  
Stephen R. Smith  
Steven J. Smith  
Norman P. Soloway  
H. David Stein  
Gary M. Stuart  
Roger J. Sullivan  
Richard N. Sutton  
William M. Taylor  
Daniel E. Thornhill  
Ronald R. Troutman  
Melvin B. Weiss

# 1963

Paul D. Abramson, Jr.  
Thomas R. Anderson  
Donald O. Benson, Jr.  
Walter H. Berninger  
Steven L. Bernstein  
Woods Bowman  
Dean W. Boyd  
Stephen B. Bram  
Neal J. Carron  
Eric R. Cosman  
Barton E. Cramer  
Frederick E. Cunningham  
Laurence E. Demick  
Steven R. Dittmeyer  
Michael A. Dloogatch  
Bruce A. Eisenstein  
Roger H. Elton  
James E. Evans  
John K. Flicker  
Frank Y. Fradin  
Anthony W. Geisler  
Russell J. Gershman  
Thomas A. Goddard  
Milton J. Grebler  
James M. Harris  
E. Norman Hernandez  
Groves E. Herrick  
James W. Holcroft  
Christina H. Jansen  
William A. Jessiman  
Jeremy A. Klainer  
Kenneth M. Klein  
Stuart Kurtz  
John J. Lamberti, Jr.  
Robert M. Levin  
Alan T. Marty

Robert M. Mason  
Ronald W. Matlin  
John H. Meyn  
Dale E. Miller  
Kenneth C. Millett  
Peter M. Mlynaryk  
Robert H. Morse  
Theodore H. Myer  
Henry R. Nau  
Ruth R. Nelson  
Lewis A. Neuman  
James W. Nick  
Lawrence H. Pitts  
Russell E. Prins  
Robert J. Purdy III  
Alan O. Ramo  
Daniel R. Ross  
Michael J. Schaffer  
Victor D. Scheinman  
Joel E. Schindall  
Charles C. Schumacher  
Charles L. Siddons  
Gene D. Sprouse  
Garrett Stone  
James Y. Tang  
Louis S. Thompson  
Robert E. Turtz  
Peter T. Van Aken  
Roger N. Wallace  
Ronald A. Walter  
Robert A. Warman  
Anthony M. Weikel  
Patricia A. White  
Cynthia K. Whitney  
William J. Wolf, Jr.  
Edgar Allen Womack, Jr.  
Boh K. Yap

# 1964

K. Andrew Achterkirchen  
Julian R. Adams  
Walter M. Anderson, Jr.  
F. Michael Armstrong  
Alexis T. Bell  
Leslie M. Boring, Jr.  
Wayne F. B'Relis  
Richard A. Carpenter  
James Chang  
Ronald H. Cordover  
Bruce E. Crocker  
Theodore J. Cruise  
Franklin P. Darmory  
John P. Downie  
Thomas W. Eggers  
Richard S. Fisher  
Ronald D. Frashure  
Keith D. Gilbert  
Michael B. Godfrey  
Joseph H. Hackmeier  
John N. Hanson  
Anthony J. Heatwole  
Robert H. Hobbs  
Roger L. Hybels  
Steven N. Iverson  
Robert M. Johnston  
Mark Joseph  
Leon M. Kaatz  
Philip S. Kilpatrick II  
Lowell E. Kopp  
Chun Chuan Kwong  
Mark G. Lappin  
Roger K. Lewis  
William B. McClure  
Austin L. McKenney  
Stephen B. Miller  
William E. Morton  
William A. Nelson, Jr.  
Kenneth J. Olshansky  
Mark R. Ordover  
David R. Patterson  
George Piotrowski  
James A. Rome  
Robert L. Rothman  
Emilio Sardi  
James R. Schomer  
David Sheena  
Fred P. Silverstein  
Jay M. Tenenbaum  
William L. Wallace  
John W. Weber  
William R. Young

# 1965

Arnold R. Abrams  
Warren L. Anderson  
John F. Beckmann  
Edward A. Bucher  
Edmund L. Burke  
Arthur A. Bushkin

W. David Carrier III  
Karl Chang  
Calvin E. Cordulack  
Charles W. Deane IV  
Daniel S. Diamond  
J. Stephen Duerr  
Michael Edesess  
James L. Elliot  
Sidney J. Everett  
Jeffrey L. Forman  
William T. Freed  
Peter G. Gerstberger  
Robert P. Goldberg  
John J. Golden, Jr.  
Robert B. Grady  
Scott O. Graham  
Joel C. Greenwald  
George L. Hadley  
Thomas F. Hallam  
Roger Harvey  
Howard L. Helman  
Michael D. Huke  
John G. Kassakian  
William N. Kavesh  
Michael A. M. Keehner  
Fred R. Kern, Jr.  
David M. Kettner  
Louis A. Kleiman  
Jesse B. Lipcon  
George W. McKinney III  
Walter L. Miller  
Eric R. Morrow  
Herbert W. Mower  
Edwin C. Moxon  
Kayson Nyi  
Piermaria J. Oddone  
Calvin F. Opitz  
Abraham R. Paltiel  
James M. Piepmeyer  
Robert B. Reichelt  
Sharon C. Ross  
Emile Sabga  
William C. Samuels  
Gregory L. Schaffer  
Stephen A. Schutz  
Charles D. Seniawski  
Peter Sexton  
Donald L. Shulman  
Richard S. Shultz, Jr.  
Douglas C. Spreng  
Richard L. St. Peters  
Alan R. Stottlemeyer  
Philip E. Strause  
Richard W. Sullivan  
Frank J. Weigert  
Henry B. Weil  
Michael G. Weiss  
Barry D. Wessler  
Joel Westerman  
Jarrod W. Wilcox  
Stephen L. Williams  
David L. Yuille  
Bruce C. Zotter

# 1966

James H. Batchelder IV  
Kenneth W. Baxter, Jr.  
Paul A. Branstad  
W. Sumner Brown  
William L. Bunce  
William O. Cain  
Thomas A. Casey, Jr.  
Richard A. Clark  
Peter M. Cukor  
Ralph M. Davison  
John W. Dawson, Jr.  
James C. Deckert  
Steven H. Disman  
James C. Edgerton  
Charles E. Fallen  
Lewis H. Gaines  
A. Mark Glickstein  
Paul G. Godfrey  
Melvin H. Goldman  
Kenton A. Griffiths  
Frederick Gruhl  
Richard K. Ho  
John F. Hoffmeister III  
Jonathan W. Hopkins  
Thomas H. Hutzelman  
Robert R. Jackson  
Philip M. Jacobs  
Kenneth J. Kepchar  
William J. Kosinar  
Martin Krone  
James P. Lavine  
Michael R. Leavitt  
Gerald B. Lichtenberger

David B. Liroff  
Bruce A. Magnell  
Henry H. Perritt, Jr.  
Enrico C. L. Poggio  
Thomas A. Rice  
Michael D. Rinaldi  
Ralph G. Schmitt  
Mark S. Schwartz  
Barry P. Skeist  
Joseph I. Smullin  
Frank E. Surma, Jr.  
John Torode  
John H. Turner, Jr.  
Tomas F. Van Tienhoven  
Ronald W. Ward  
Robert A. Wells, Jr.  
Malcolm E. Wheeler  
H. Allen White III

# 1967

John Acevedo  
Donald A. Belfer  
Victor M. Bermudez, Jr.  
Donald J. Bosack  
Paul J. Caragine  
John W. Cook  
John M. Davis  
Gordon J. De Witte  
M. William Dix, Jr.  
Tomme W. Ellis  
D. Travis Engen  
Kenneth G. Follansbee  
Barbara A. Gilchrist  
Lewis B. Golovin  
Howard J. Greenbaum  
Lawrence C. Hall  
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Edson C. Hendricks  
Robert C. Hewitt  
Alan R. Hirsch  
Charles R. Holdaway  
Charles E. Kolb, Jr.  
Alan E. Kruse  
Arthur C. Kwok  
Andrew C. Lemer  
Eric K. Li  
Donald A. Mattes  
John D. McClain  
Douglas L. McCraith  
Victor Myev  
Donald R. Oestreich  
Lin Olsen  
John S. Podolsky  
John C. H. Reykjalinn  
Stanley M. Rose  
James E. Rumbaugh  
George S. Sacerdote  
Chester L. Sandberg, Jr.  
John M. Shufelt, Jr.  
Gerald B. Siegel  
Melvin Snyder  
Karsten Sorensen  
Neil Steinmetz  
James A. Swanson  
Robert C. Todd  
James C. Tsang  
Bruce A. Twickler  
Eugene L. Venturini  
Glenn A. Wanek  
Jeffrey M. Wiesen

# 1968

Platte T. Amstutz III  
Robert B. Anthonyson  
Richard E. Boyatzis  
Marilyn M. Bruneau  
Donald R. Bruns  
Samuel A. Cohen  
Arthur E. Cole, Jr.  
Fredda H. Cole  
Shan Cretin  
Vahe Davidkhanian  
Christopher J. Davis  
David J. Dimlich  
Paul A. Forbes  
Julian P. Freret, Jr.  
Paul A. Gluck  
George M. Goldmark  
Peter Groot  
Daniel G. Gruber  
Alan E. Harger  
Robert T. Haslam III  
Jay J. Hellman  
Robert C. Hendel  
James C. Hsia  
Paul C. Kimball  
Craig W. Kirkwood  
Timothy H. Kjellberg  
Richard L. Klass



A. James Laurino  
Jonathan M. Lehr  
Robert Y. Li  
John P. Linderman  
Scott P. Marks, Jr.  
Robert L. McCrory, Jr.  
Scott J. Mermel  
G. Allen Merry  
Charles B. Miller, Jr.  
Paul L. Modrich  
Jesper Munch  
William M. Parks  
Darryl Pomietter  
Hughes Pope, Jr.  
Richard E. Reese  
David J. Roberts  
Joel P. Robinson  
Ronald S. Rosen  
Kenneth I. Rosenberg  
Benton H. Schaub, Jr.  
Leonard H. Schrank  
Jonathan D. Shane  
Robert M. Supnik  
Randall Warniers  
William G. Zink

**1969**  
Phillip T. Balazs  
Burt S. Barnow  
William P. Bengen  
James H. Black, Jr.  
Mark L. Braunstein  
Paul D. Brophy  
Charles W. Buenzli, Jr.  
David A. Cane  
Marc Davis  
David L. Dewitte  
Gary C. Dixon  
Robert H. Dobson  
Bruce R. Donath  
Mark Drazen  
H. William Ebeling, Jr.  
David B. Erickson  
Ka-Hung Fogg  
Matthew M. Franchewicz, Jr.  
Bruce D. Glabe  
Jeffrey H. Grotte  
Bruce K. Hamilton  
Robert J. Harrington  
Bruce L. Heflinger  
Stephen A. Hill  
John M. Hirsch  
Joseph A. Horton  
Kenneth R. Hules  
Jan S. Jurnecka  
John F. Kaar  
David P. Kelleher  
Thomas H. Kick  
Morris Kinast  
Bernard E. Klein  
Richard D. Kremsdorf  
Carl W. Kuhn, Jr.  
Michael W. Laird  
W. David Lee  
Ronald J. Lepkowski  
Stanley B. Limpert  
Mark B. Lively  
John I. Loewenstein  
Robert G. McGregor  
Geraldine G. Miller  
Dean S. Musgrave  
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Edward L. Parsons, Jr.  
Peter Peckarsky  
Roy F. Quick, Jr.  
Jeremy K. Raines  
James S. Rhodes  
William Lee Roberts  
Franklin P. Rogers  
Christopher R. Ryan  
James J. Sanders III  
John D. Schmitz  
Joel I. Seiferas  
Richard G. Smith  
Thomas E. Stewart  
William T. Stewart  
Kathryn A. Street  
Walter P. Suchon  
William H. Thomas, Jr.  
Michael P. Timko  
James P. Truitt, Jr.  
Michael J. Underhill  
Hal R. Varian  
Hermes R. Velez-Juan  
Eben T. Walker  
Jeffrey M. Weissman  
Smith T. Wood  
Norman S. Yee

Wayne A. Zafft  
Robert R. Zimmerman  
**1970**  
Ronald Abramson  
Barry R. Allen  
Richard A. Anderson  
O. Reid Ashe, Jr.  
Irving M. Asher  
Douglas F. Bender  
James C. Bronfenbrenner  
Paul Burstein  
James L. Caldwell  
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Eric K. Clemons  
Stephen F. Cooper  
David P. Dobkin  
Ireneed duPont III  
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Harold M. Ting  
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Michael S. Venturino  
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Harold M. Wilensky  
Carl J. Yankowski

**1971**  
Richard A. Aparo  
Kenneth A. Bauer  
Ilyas Bayar  
Robert F. Beckley III  
Gregory K. Bernhardt  
Joseph K. Boddiford, Jr.  
Glen A. Brunk  
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Gim P. Hom  
Martin L. Jack  
Janet A. Koch  
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Eric A. Kraemer  
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Jeffrey D. Kurtze  
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David L. Lapidus  
P. David Lebling  
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Robert P. Lidral

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Timothy J. Maloney  
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Lawrence E. Schmutz  
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James D. Shields  
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Alfred M. Solish  
John A. Stefano  
Patrick B. Sullivan  
Edward J. Vaver  
Joseph B. Walters, Jr.  
Richard H. M. Willoughby  
R. Dale Zellers

**1972**  
Paul W. Andrus  
Joseph A. Auer, Jr.  
Douglas Graydon Bailey  
Bradley C. Billedeux  
John M. Bissell  
Kenneth M. Brown  
Jack E. Cater  
Terrill J. Chang  
Leonidas P. Colakis  
Richard G. Collarini  
Don Coppersmith  
Wilhelm Daida  
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James W. Roxlo  
Lynn M. Roylance  
Hikaru P. Shimura  
David Shpilberg  
Leonard H. Sigal  
Sarah J. Simon  
Dean Solomon  
Michael F. Sweeney  
R. Daniel Witschey, Jr.  
Albert S. Yee

**1973**  
Barton W. Adrian  
Bertrand C. Barrois  
Jay F. Benesch  
John R. Bertschy  
Roger P. Bowers  
Richard A. Chaprie  
Frans Christ  
Alan Cisar  
Rodney B. Corlin  
Mary Jean Crooks  
Robert G. Eccles, Jr.  
Thomas E. Ellis  
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John R. Gersh  
Mateo Go, Jr.  
Paul A. Green II  
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B. John Lange III  
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John A. Lippitt  
Patrick A. Marcotte  
Howard Messing  
Stephen P. Miller  
Joseph H. Mirzoeff  
Frederic S. Mishkin  
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David J. Moylan III  
Mark Carroll Oakes

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Martin Romeo  
Jeffrey P. Seltzer  
Alan G. Spoon  
Thomas R. Stagliano  
Paul A. Swartz  
Donald Lew Tatzin  
William W. Toy  
Dennis Tully  
John W. van der Meer III  
John C. Weaver  
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David R. Wilson  
Charles A. Ziering, Jr.

**1974**  
James Richard Andrew  
Edwin M. Aripoll  
Frank Commons  
William Lloyd Donner  
Michael Peter Filosa  
Matthew Fowler  
Edward C. Giaimo III  
Marc Avi Goldring  
Charles E. Granatir  
Richard Alan Hartman  
Rodney C. Hartman  
Michael J. Hassett  
Charles Edward Hillman  
John Widtman Hurd  
Michiro Iwanaga  
Bruce Irwin Judelson  
Steven Candido Lausell  
Manuel A. Malagon-Fajar  
Gary H. Miyashiro  
Andrew W. Moehlenbrock  
Barry Nathan Nelson  
Gary Lee Peskin  
John Emery Plum  
Gary David Raymond  
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Juniper T. Russell  
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Todd Allen Smith  
W. Wayne Stargardt  
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R. Gregory Turner  
Alan L. Unemori  
Jay W. Van Dwingelen  
Denny On Yat Wang  
Jeffrey C. Weinreb  
Douglas W. White  
Dirk Adrian Zwemer

**1975**  
Kenneth J. Armstead  
Peter P. Blanshan  
Jeffrey M. Broughton  
Patricia R. Callahan  
Martin R. Cawthon  
John Dana Chisholm  
Mark R. Dahl  
Leonard J. De Roma  
Kenneth M. Deemer  
Joseph W. Dehn III  
Natalie J. Dehn  
Loren E. Dessonsville  
Moray P. Dewhurst  
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Thomas Durgavich  
M. Bruce Fegley, Jr.  
Elliot J. Feit  
Charles Fendrock  
Frank P. Fezzie, Jr.  
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Guy Harris  
Henry G. Heck  
David L. Hendry  
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Donald W. Inadomi  
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Michael G. Kozinetz II  
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Karl I. Li  
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Richard J. McCarthy  
Thomas F. McKim  
Denny E. Morgan  
Scott H. Oldach  
Victor C. Pei  
F. Patrick Schultz  
Donald E. Shobry

Algirdas J. Skrinka  
John Robert Stiehler  
Lena H. Sun  
Arlo F. Weltge  
Michael E. Wilens  
**1976**  
Joel M. Berez  
Eric L. Bogatin  
Thomas P. Chang  
Jeslie R. Chermak  
Caroline Chiles  
Michael W. Dziekan  
Andrew S. Farber  
H. Lee Gearhart  
Jeffrey S. Halis  
John J. Hanzel  
Douglas M. Johnston  
Mark E. J. Keough  
James W. Lambert  
Campbell M. Lange  
Reynold Hans Lewke  
Kelly P. McClellan  
Eric H. Michelman  
Janis B. Ossmann  
Susan A. Riedel  
Linda Q. Sax  
John D. Schoedel, Jr.  
David C. Shaver  
Lee M. Silberman  
James P. Wajda  
Franklin E. Withrow III

**1977**  
William Baum  
David R. Bieberle  
Richard W. Buck  
Michael C. Cohen  
Gary A. Dobos  
T. M. Eubanks  
David R. Fett  
Thomas B. Fetter  
A. Ramiro Garron-Torrez  
Michael J. Haney  
Brian G. R. Hughes  
Thos A. Kush  
Wing Hong Ricky Lee  
Kevin B. Miller  
Thomas C. Mills  
Robert F. Miracky  
Charles G. Mogged, Jr.  
Timothy F. Morison  
Daniel A. Nolet  
Richard M. Smiley  
Leslie Faye Sutton  
Barbara A. Thornton  
L. E. Watlington

**1978**  
Bradley S. Albom  
Gary J. Asakawa  
Victor L. Bigio  
Kevin F. Brennan  
Richard H. Brudnick  
David B. Burstein  
Mark L. Bye  
Alice E. Campbell  
Trieu C. Chieu  
Peter C. Coffee  
Eliav Dahan  
John B. Dell'Aquila  
William T. Fejes, Jr.  
Janet E. Freeman  
James J. Heeger  
Gary M. Heiligman  
Jeffrey S. Hovis  
Vincent W. James  
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Steven T. Kirsch  
Thomas F. Knight, Jr.  
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Donald B. Mellen  
Francis E. Murphy III  
Teresa C. Nolet  
George M. Orlov  
Barbara K. Ostrom  
Anthony L. Otten  
Jeffrey R. Pollack  
Kirk L. Reistroffer  
Robert G. Resnick  
Leslie Rosenthal Shlecter  
Howard Shao  
Eric R. Shienbrood  
Andrew A. Stern  
John E. Swindle  
Steven C. Webster  
Arthur Wright

**1979**  
Susan Jane Colley  
Keith L. Dimorier  
Jeffrey N. Dugal  
John J. Fraticchio, Jr.  
Norman R. Guivens, Jr.  
Andreas G. Hegedus  
Dale V. Hodson  
David A. Holt  
Donald Jue  
Sally C. Kornfeld  
Ellen Leckband  
Gerald T. Michael  
Barry A. Newman  
Louis J. Paglia  
Brenda Pomerance  
John F. Pries  
Jonathan A. Reiss  
Larry S. Rosenstein  
Charles B. Roxlo  
Jeffrey J. Russell  
Jeffrey I. Schiller  
Scott H. Wayne  
Eric N. Whitney  
Bruce J. Wrobel

**1980**  
Frederick D. Baker  
Jeffrey H. Berman  
Thomas S. Borecki  
Jane H. Chronis  
Mark F. Connaughton  
Ann Marie Connor  
Thomas A. Curtis  
William H. Harper  
Christopher T. Hibbert  
Frank E. Huston  
Jeffrey M. Jaycox  
Barbara M. Johnston  
Timothy J. McManus  
Terry S. Neiman  
Kenneth D. Oya  
Howard W. Seidler

**1981**  
Walter R. Crosby  
Irene M. Dale  
Warren J. Dew  
George M. Dowd  
Tso Ye Fan  
John R. Fierke  
Ellen C. C. Fischer  
A. David Himle  
Roger A. Ishimoto  
Glenn L. Katz  
Judith K. Lemire  
Charles I. McCauley  
Mark W. Merritt  
Duane T. Nakahata  
John A. Noone  
William I. Ogilvie  
Jon M. Peltier  
David L. Pinckney  
Christopher S. Wheeler

**1982**  
Arno S. Bommer  
Thomas J. Calderwood  
Douglas M. Chin  
Michael G. Feinstein  
Charles Frankel  
David P. Franhay  
Fred W. Helenius  
James E. Lewis  
Philip B. Romanik  
Chi-Won Yoon

**1983**  
Paul S. Cunningham  
Carroll L. Dodson  
Raymond E. Goldstein  
Marvin Hom  
Lawrence J. Kaufman  
Barry Margolin  
John E. Mracek  
Hyun-A C. Park  
Rhonda J. Shaw  
James E. Thomas, Jr.

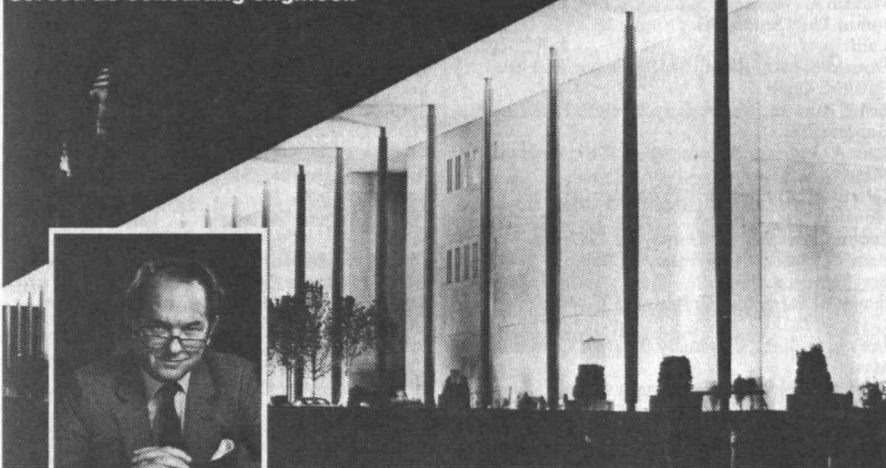
**1984**  
Ralf Harteneck  
Michael E. Landmeier  
Robert H. Leong  
Mark A. Robien

**1985**  
Michael M. How

**1986**  
Michael J. Ho  
Paul A. Moschetti



The John F. Kennedy Center for the Performing Arts is just one of many structures for which John F. Hennessy, '51, served as consulting engineer.



#### John F. Hennessy, 1929-1989

John F. Hennessy, '51, who supervised the engineering design of many of the country's prominent buildings, died in his office on January 9 of a heart attack; he was 60.

In 1951 Hennessy joined Syska & Hennessy, the consulting engineering firm begun by his father in 1928. He was elected president in 1967 and became chairman and CEO in 1973. During his 38 years as an engineer, Hennessy's projects included the Lincoln Center for the Performing Arts, Madison Square Garden, LaGuardia Airport, and the Jacob K. Javits Convention Center in New York; the John F. Kennedy Center for the Performing Arts in Washington, D.C.; and King Saud University in Saudi Arabia.

Active in community, civic, philanthropic, political, and educational areas, Hennessy was a member of the Visiting Committee of the Sloan School of Management, a past director and campaign chairman for the New York Heart Association, and on the board of directors of the New York Association of Consulting Engineers, where he was a past president. He was a trustee of the Hall of Science in New York, and a Fellow of Photography of the Museum of Modern Art. □

#### Jacob P. DenHartog, 1902-1989

Jacob P. DenHartog, professor emeritus of mechanical engineering at MIT and an internationally known lecturer, died

on March 17 in Hanover, N.H.; he was 87.

DenHartog, born in Indonesia and educated in Holland, came to the United States in 1924 and received a PhD from the University of Pittsburgh. After teaching at Harvard from 1932 to 1941 and active duty in the Navy during World War II, he began teaching at MIT in 1945, retiring in 1967. He served as the head of the Department of Mechanical Engineering from 1954 to 1958. He lectured at many leading U.S. universities and 60 foreign schools as a Fulbright professor and continued to work as a consultant and lecturer until 1980.

The author of many textbooks, DenHartog was best known for *Mechanical Vibrations*, first published in 1932; by 1966 it was in a fourth edition, reprinted in 11 languages and 15 foreign editions. DenHartog received several honorary degrees and numerous awards, including the Founders Award from the National Academy of Engineering and the James Watt Medal from the British Institute of Mechanical Engineers. □

#### Deceased

The following deaths have been reported to the Alumni Association since the *Review's* last deadline:

Mrs. Norman E. Seavey, '99; April 28, 1988;

Orlando, Fla.

Arthur H. Curtis, '10; February 17, 1989; Sebago Lake, Maine.

Charles S. Gardiner, '15; May 13, 1988; Cleveland, Ohio.

Russell S. Palmer, '19; December 23, 1988;

Chestnut Hill, Mass.

Robert H. Brown, '22; January 6, 1989.

Yen-Ting Chou, '22; February 13, 1989.

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Soil Scientists	
Municipal Services	Boston, MA
Landscape Architects	617-783-0404
Environmental Consultants	Providence, RI
	401-751-2235
Florham Park, NJ	Washington, DC
201-822-2600	202-785-8433
Robbinsville, NJ	
609-259-0640	
Manchester, NH	
603-623-5544	
Wethersfield, CT	
203-529-7727	

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	Kenneth L. Recker '73
	Mark X. Haley '75
	Robin B. Dill '77
	Andrew F. McKown '78
	Keith E. Johnson '80
	Deirdre A. O'Neill '85
	Chris N. Erikson '85
	Gretchen A. Young, '86
	Christian de la Huerta, '87

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**Samuel I. Zack**, '22; February 19, 1989; Boca Raton, Fla.  
**Andrew G. Crowley**, '23; February 26, 1989; Burlingame, Calif.  
**Frank P. Knight**, '23; September 27, 1988; Phoenix, Ariz.  
**James F. Crist**, '24; December 28, 1988; Atlanta, Ga.  
**H. Wesley Leavenworth**, '25; May 19, 1988; Waterbury, Conn.  
**Roland T. Seabury**, '25; January 13, 1989; North Weymouth, Mass.  
**Lynn Wetherill, Sr.**, '25; April 22, 1988; Pittsfield, Mass.  
**Alden W. Peterson**, '26; July 14, 1988; Sturgis, Mich.  
**Kenneth W. Martin**, '29; January 27, 1989; Buzzards Bay, Mass.  
**Austin S. Norcross**, '29; January 26, 1989; Newton, Mass.  
**Jules Leblanc**, '29; February 4, 1986; Montreal, Canada.  
**C. Thurston Ramsey**, '30; October 18, 1988; Melbourne, Fla.  
**George E. Shrigley**, '30; February 10, 1989; Framingham, Mass.  
**Lewis S. Hyman**, '31; January 3, 1989.  
**Francis D. Matthews**, '31; December 8, 1988; San Carlos, Calif.  
**Walter A. Lazar**, '32; February 6, 1989; Needham, Mass.

**William E. Potter**, '33; December 5, 1988; Orlando, Fla.  
**J(ohn) Terry Smith**, '33; October 28, 1988; Dublin, Calif.  
**Donald S. McQuillan**, '34; December 20, 1989; Suffield, Conn.  
**Leo J. Kramer**, '36; February 20, 1989; Palm Beach Gardens, Fla.  
**John A. Murley**, '37; January 31, 1989; Westport, Mass.  
**George H. Shipley, Jr.**, '37; January 20, 1988; Houston, Tex.  
**Lydon Crawford**, '38; January 18, 1989.  
**Peter de Florez**, '38; February 21, 1989; San Francisco, Calif.  
**James H. Ferry, Jr.**, '39; February 25, 1989; Glencoe, Ill.  
**Reevan Spiller**, '39; January 20, 1989; Cambridge, Mass.  
**Clark E. Taylor, Jr.**, '39; February 3, 1989; Wilton, Conn.  
**Lois W. Langhorst**, '40; January 6, 1989.  
**Laurent O. Dubois, Sr.**, '41; February 5, 1989; Pocasset, Mass.  
**Raymond G. O'Connell**, '41; April 1989; Litchfield, Conn.  
**Richard W. Bloomingdale**, '42; September 23, 1988; Tucson, Ariz.  
**Richard B. Morrison**, '43; January 23, 1989; Tavernier, Fla.  
**George K. Turner**, '45; December 6, 1988; Los Altos, Calif.

**Nichols W. Caldwell**, '48; December 15, 1988; Marblehead, Mass.  
**George R. Cooper, Jr.**, '48; February 27, 1987; Slingerlands, N.Y.  
**John B. Rickey**, '50; November 17, 1984; Altamonte Springs, Fla.  
**Walter O. Davis**, '51; January 29, 1989; Brockton, Mass.  
**Andrew R. Hutson**, '54; December 20, 1988; Summit, N.J.  
**William Patten**, '54; January 23, 1989; Portage, Mich.  
**Dennis E. Johnson**, '56; February 3, 1989.  
**John W. Patierno**, '56; February 25, 1989; Newport Beach, Calif.  
**Gerald G. Probst**, '56; January 16, 1989; Salt Lake City, Utah.  
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**Alfred M. Pride**, '60; December 24, 1988; Arlington, Va.  
**Stanley M. Kulpa**, '61; November 15, 1987; Bethesda, Md.  
**Philip H. Lawrence**, '62; January 20, 1989; Vero Beach, Fla.  
**Jean-Michel Charuet**, '63; July 6, 1986; Gagny, France.  
**Akiko Higa**, '64; October 1, 1988; Ibaraki, Japan.  
**Edward H. Seymour**, '66; December 24, 1988; Doylestown, Penn.  
**Tomas F. van Tienhoven**, '66; December 21, 1988; London, England.

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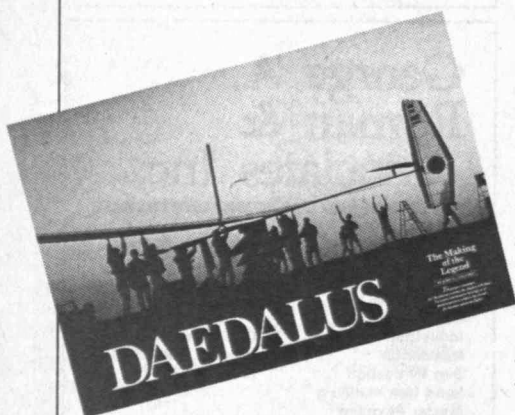
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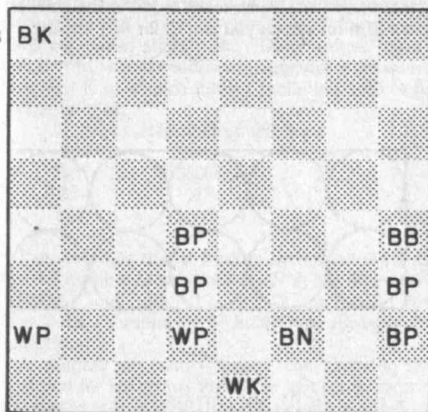
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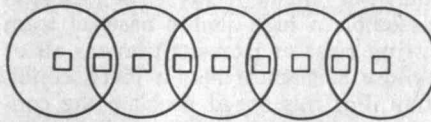
As I have mentioned previously, George Almasi and I recently wrote a book entitled *Highly Parallel Computing* published by Benjamin Cummings. George has asked me about the possibility of doing another book, this time based on "Puzzle Corner." The new book would mainly include selected problems and solutions but would also have a few of the more personal comments that have appeared from time to time. As some of you may remember, several times in the past I mentioned inquires about a possible *Best of Puzzle Corner* book, but none of them has ever developed. George, however, will make sure that a book appears if we decide to go ahead. What do you think? Go or No Go, and if the former any suggestions on content or format?

### Problems

**M/J 1.** We begin with a two-part chess problem that appeared in *The Tech* during 1984. First, in the figure below, find a helpmate in 7, i.e., black moves first and cooperates with white so that black is mated on white's 7th move. Second, solve the same problem with the bishop on H4 gone.



**M/J 2.** Nob. Yoshigahara wants you to put a unique digit from 1 to 9 in each of the nine boxes so that the sums in the circles are all equal.

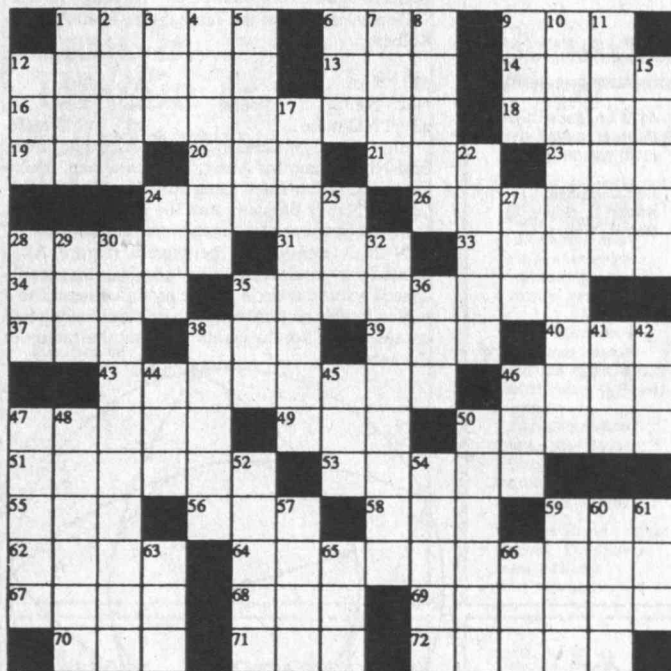


**M/J 3.** Thomas Murley asks, for a random physical constant, what is the probability that its *second* digit is *n*?

**M/J 4.** Robert Bart extends a problem posed last year and asks for the smallest positive integer *A*, such that  $(A)^{1/n}$  begins

with 10 distinct digits. Note that  $A_1 = 1023456789$  (leading zeros are not permitted) and that we established  $A_2 = 1362$  last year. ( $1362^{1/2} = 36.90528417 \dots$ ). Mr. Bart specifically asks for  $A_3$  through  $A_{10}$ .

**M/J 5.** Our last regular problem is not that regular; it is a crossword puzzle from Andrew Greene published last year in *The Tech*. I have no objection to including these kinds of problems but want to know what you think.



### ACROSS

- 1 Follicle outgrowths
- 6 Mal de \_\_\_\_\_
- 9 760 mmHg
- 12 Portion of
- 13 Much \_\_\_\_\_ About
- 14 Anti-fly team?
- 16 Part of M.I.T.
- 18 "\_\_\_\_\_, I don't think we're in Kansas anymore"
- 19 Draft org.
- 20 Compass dir.
- 21 NCC-1701-D crewmember
- 23 Dine \_\_\_\_\_
- 24 Bloodsucker
- 26 Strata
- 28 "\_\_\_\_\_ him now or wait 'til you get home"—Bugs Bunny
- 31 Golf item

- 33 \_\_\_\_\_ Jones' locker
- 34 First video game
- 35 Massachusetts \_\_\_\_\_
- 37 Ripen
- 38 Preposition
- 39 B'way abbr.
- 40 Type of gate
- 43 Kind of hash
- 46 Po follower
- 47 Gewitter, \_\_\_\_\_
- (Movement from Beethoven's sixth symphony)
- 49 Red or Black, e.g.
- 50 Sanctuaries
- 51 Wrote
- 53 Dynasty star Linda
- 55 Finish
- 56 Coke cops
- 58 British record co.
- 59 Bee chaser
- 62 Cheers cheer
- 64 M.I.T. sports, e.g.
- 67 \_\_\_\_\_ Scott case

- 68 Teleflora competitor
- 69 Falcons
- 70 "Star Wars"
- 71 Affirmative
- 72 Hamlet word

### DOWN

- 1 Shades
- 2 Fundamentals
- 3 Man from Tel Aviv
- 4 Stomach lining
- 5 British weight
- 6 Chinese ruler
- 7 Nervous
- 8 Kingly
- 9 Computer supply co.
- 10 Contest on Nov. 24, 1987
- 11 Ripen
- 12 Pt. of Course XXI
- 15 Turvy's partner
- 17 LSC events
- 22 No soap
- 24 Journal
- 25 Pronoun
- 27 Gab
- 28 Health resort
- 29 Swine
- 30 Integer often following 26
- 32 One who captures and sells people
- 35 Mazel \_\_\_\_\_!
- 36 Be nosy
- 38 Well-known
- 41 OPEC concern
- 42 Co. between NBC and GE
- 44 Bird
- 45 Born as
- 46 Curve on a road
- 47 Use money
- 48 Some Logarithms
- 50 Beast
- 52 Worship as a god
- 54 Collect
- 57 Poker start
- 59 Indian tribe
- 60 Wyatt \_\_\_\_\_
- 61 Subways that aren't subways
- 63 MMMII halved
- 65 6 pts. in football
- 66 Fiddle's cousin



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## Speed department

SD 1. We once again begin this section with an offering from Jim ("Sir Speedy") Landau who wants to know in what year *The Pirates of Penzance* takes place.

SD 2. Frank Model writes that he and Mike Bertin have been concocting what they call "theme teams". The idea is to assemble a high-quality baseball team using past or present players all of whose surnames meet a given condition. For this speed problem the condition is that the surname is Robinson. Players must play their natural position but all three outfields are considered interchangeable.

## Solutions

JAN 1. Robert Bart wants to know the shortest chess game that ends in a true smothered mate, i.e., only the square the king is on is under attack, all the adjacent squares are blocked by "friendly" forces.

Two variations on the same theme from Andrew Kolbert:

e3	Nc6		e3	Nc6
Ne2	Ne5	and	Ne2	Ne5
g3	Nf3 mate		c3	Nd3 mate

Also solved by Gordon Rice, Thomas Harriman, Bob High, Timothy Allen, Joe Kesselman, Philip Dangel, Lyndon Tracy, Greg Spradlin, Stephen Callaghan, Nancy Burstein, and the proposer.

JAN 2. A non-Satanic pentagram (Figure A) is formed by intersecting five circular arcs evenly spaced around a circle. These arcs are tangent to a radius 1 circle concentric to the first and having half its area. Ken Rosato wants to know the radius of the arcs.

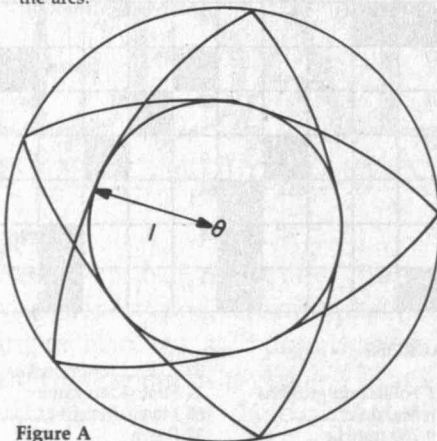


Figure A

Timothy Allen sent us the following solution.

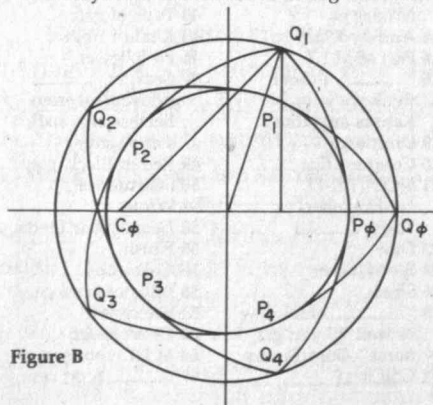


Figure B

All five tangent arcs have equal length radii. That length,  $r$ , has the following value and is given by the following formula:

$$r = 1.888124745$$

$$r = (1.5 - c)/(1.0 - c)$$

where

$$\sqrt{2\cos 2\pi/5}$$

First, note the five-fold symmetry of Figure A. Without loss of generality, we can impose the coordinates (shown in Figure B). Both circles are centered at the origin. The inner circle has radius 1. The outer circle, which has twice the area of the inner circle, has radius  $\sqrt{2}$ . By symmetry, the origin, the tangent points on the inner circle, and the corresponding intersection points on the outer circle are collinear. Also by symmetry, the five tangent points on the inner circle,  $P_K$ , have coordinates (when written in complex number form) equal to the five fifth (ie,  $1/5$ ) roots of unity; and the five intersection points on the outer circle,  $Q_K$ , are scalar multiples, as follows:

$$P_K = \text{cis}(2\pi K/5)$$

$$Q_K = \sqrt{2} P_K$$

where:

$K$  ranges from 0 to 4,

$\text{cis}(x) = \cos(x) + i \sin(x)$ , in complex form,  
 $\text{cis}(x) = (\cos(x), \sin(x))$ , in coordinate form.

Consider the arc that is tangent to the inner circle at the unity point,  $P_0 = \text{cis}(0)$ . Its center,  $C_0$ , is located on the negative side of the  $x$ -axis. The distance from the center,  $C_0$ , to the tangent point,  $P_0$ , which is the radius,  $r$ , equals the distance from the center,  $C_0$ , to the first intersection point on the outer circle,  $Q_1$ , which is also the radius,  $r$ . Also,  $Q_1 = \sqrt{2} \text{cis}(2\pi/5)$ . This yields the following equations:

$$C_0 = (1 - r, 0)$$

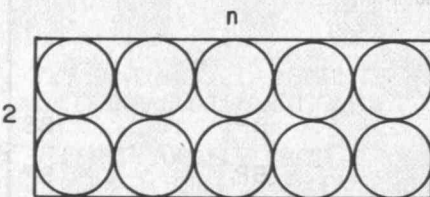
$$\text{Distance}(C_0 \text{ to } P_0) = \text{distance}(C_0 \text{ to } Q_1)$$

$$r^2 = [(1 - r) - \sqrt{2} \cos(2\pi/5)]^2 + \sqrt{2} \sin(2\pi/5)^2$$

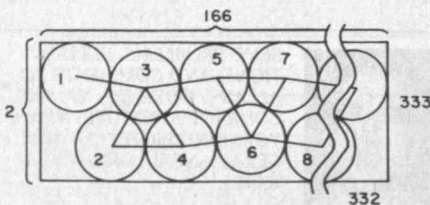
By simplifying this, we get the value and formula given above.

Also solved by Thomas Harriman, Bob High, Harry Zarembo, Gordon Rice, Robert Buegler, Winslow Hartford, Scott Berkenbilt, Eugene Sard, Sidney Williams, Kelly Woods, Andy Schwartz, Edward Dawson, Mary Lindenberg, Fred Furland, and the proposer.

JAN 3. As illustrated below it is easy to put  $2n$  unit diameter circles inside a  $2 \times n$  rectangle. Nob. Yoshigahara and J. Akiyama want to know the smallest value of  $n$  for which you can fit  $2n + 1$  circles.

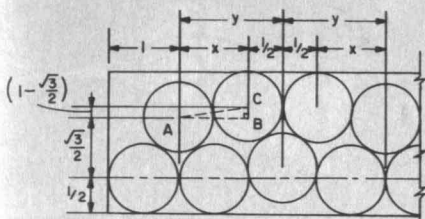


Pretty tricky! Many respondents believed that no solution was possible. Bob High found a solution for  $n = 167$  and one of the proposers, Nob. Yoshigahara, included the following figure to illustrate a solution for  $n = 166$  and notes that the clearance in the long direction is less than 0.0007.





The minimal solution for which I received the complete construction is the following  $n = 166.5$  submission from Harry Zarembo:



The smallest  $n$  for which  $(2n + 1)$  unit diameter circles can fit into a  $2 \times n$  rectangle equals 166.5. An arrangement where this is possible is indicated in the figure. The circles are arranged in groups of three with the circles in each group tangent to each other, and alternate groups have two of their circles tangent to opposite sides of the rectangle. From the geometry,

$$x = AB = (\overline{AC}^2 - \overline{BC}^2)^{1/2} = [1 - (1 - \sqrt{3}/2)^2]^{1/2} = (4\sqrt{3} - 3)^{1/2}/2$$

and,

$$y = x + 1/2 = 1.4909848.$$

It is noted that, after the first circle is positioned at the left end of the rectangle, a uniform increment of three circles is added whereby each increment increases the rectangle's length by a constant  $y$  units and its area by  $2y$  square units. Hence, for each addition of three circles, the increase in circles exceeds the increase in area by  $(3 - 2y)$  or 0.0180304. The number of  $y$  increments that must be added to make up the one-circle deficit at the beginning, and to accrue a one-circle excess at the end, is given by  $k = 2/(3 - 2y) = 110.92$  or 111.

It follows that the smallest length of the rectangle that can contain  $(2n + 1)$  circles is

$$n = 1 + ky = 166.5.$$

The number of circles in the rectangle is  $(1 + 111 \times 3) = 334$ , and the rectangle's area is  $2n = 333$ .

Also solved by Thomas Harriman, Winslow Hartford, Ken Rosato, Norman Wickstrand, Joe Kesselman, Scott Berkenbilt, and Eugene Sard.

**JAN 4.** John Rule is interested in perfect squares that when written (in base 10) use all ten digits once each. What is the smallest such number? What is the largest?

Edward Wallner solved a more general problem to illustrate that Rule was wise in specifying squares:

To generalize slightly the "Diophantine" equation  $K = M^N$  has the following numbers of solutions in which  $K$  uses each integer including zero once and only once:

N	Number of solutions
0	0
1	3628800
2	117
3...∞	0

This assumes that a leading zero is allowed. If not the number of solutions for  $N = 1$  is  $10! - 9! = 3265920$  and for  $N = 2$  is 87. For  $N = 2$  the solutions are included here for both assumptions.

A number of factors reduce the space to be searched for solutions. First, it is quicker to search among the  $\approx \sqrt{9876543210} \approx 10^5$  possible roots than among the  $10! \approx 4 \times 10^6$  permutations of the ten digits. Second, since the digital root of  $K$  is zero, the digital root of  $M$ , for  $N > 1$ , must be 0, 3, or 6. Since the digital root is divisible by 3 so is  $M$ , which reduces the search by a factor of 3. A program search from  $M \geq \sqrt{0123456789}$  to  $M \leq \sqrt{9876543210}$  by 3's gave the printed results. Similar searches gave no solutions for  $N$  from 3 to 7 at which point the possible values of  $M$  are 27 or less. The multiples of 3 up to 27 were then checked for values of  $N$  giving  $K$ 's between 0123456789 and 9876543210. None of these few values used each of the digits once only.

Also solved by Thomas Harriman, Peter Groot, Alan Taylor, Bob High, Harry Zarembo, Gordon Rice, Steven Feldman, Robert Buegler, and Winslow Hartford.

## Better Late Than Never

1988 A/S 5. John Maynard's on-time solution just turned up, having been misplaced in my files. I apologize.

ND/ 1. Alan Taylor has responded.

N/D 3. Peter Groot, Thomas Harriman, and Fred Furland have responded.

N/D 4. Peter Groot and Thomas Harriman have responded.

N/D 3. Thomas Harriman has responded.

## Proposers' Solutions To Speed Problems

SD 1. 1877. Frederic becomes 21 years old at the time of the play, yet his 21st birthday is February 29, 1940.

SD 2. Pitcher Don, Catcher Wilbert, 1B Eddie, 2B Jackie, 3B Brooks, SS Craig, and outfielders Fresh, Floyd, and Bill. Four hall-of-famers are included.

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# MIT LIFE INCOME FUNDS





# In Search of the Elusive Stealth Bomber

BY MICHAEL BROWER

*The B-2 bomber  
is a boondoggle in search of a mission,  
but Congress will probably  
fund it anyway.*

Just a few months ago the stealth bomber—whose revolutionary design is supposed to enable it to maneuver undetected inside the Soviet Union—was one of the least controversial of the Pentagon's big-budget programs. While Reagan administration officials and members of Congress butted heads over the MX and Midgetman missiles, the B-2 project breezed through hearings virtually unopposed. But today full-scale production of the bomber appears certain to be delayed, and some influential members of Congress, including Senate Armed Services Committee chair Sam Nunn (D-Ga.), have suggested that the program may have to be canceled.

This turnaround should come as no surprise,



*Cruise missiles not only  
render the stealth bomber unnecessary,  
but they are also much cheaper.*

---

even though the bomber has long enjoyed support from Democrats and Republicans alike. The aircraft's enormous cost was bound to raise problems as Congress and the Pentagon struggled to set priorities in a deficit-constrained military budget. The Defense Department now estimates that 132 stealth bombers will cost \$68.1 billion. At about \$516 million apiece, that is almost twice the price of the B-1B bomber, which was deployed just three years ago. Well-publicized difficulties with the B-1B have only highlighted questions about the Air Force's ability to manage such expensive and complex programs.

Underlying the issue of cost is the lack of a compelling need for the stealth bomber. Air-launched cruise missiles—small, low-flying drones that can be launched from aircraft outside Soviet territory—are just as powerful a nuclear deterrent, and they cost far less.

Yet the program will not be easy to kill. The B-2 supporters will be sure to

hired to begin production. Moreover, the fact that the program has long been classified leaves little room for debate over its strategic merits—points on which Congress is loathe to challenge the Pentagon anyway. The result could be a compromise all too common with marginal defense projects: a decision to build a smaller number of aircraft over a longer period at an even higher cost.

#### An Obsolete Role

**D**espite its extraordinary design, the B-2 bomber has a most traditional strategic role—and one that is all but obsolete. Its mission is to penetrate Soviet defenses and destroy targets at close range, either by dropping free-fall nuclear bombs or by launching nuclear-armed short-range attack missiles (SRAMs). During the 1940s and the 1950s, the penetrating bomber was the only means of delivering nuclear weapons to Soviet soil. To-

responsibility with ICBMs and submarine-launched ballistic missiles (SLBMs) in the "strategic triad." In 1976, President Carter halted another attempt to modernize the bomber force by canceling the B-1 program (a decision later reversed by the Reagan administration), this time because of an invention made possible by advancing technology—the cruise missile.

The United States now deploys about 1,500 air-launched cruise missiles (ALCMs) on B-52 bombers. (Despite the age of the B-52s, they are expected to remain in service until after the turn of the century.) ALCMs are inherently difficult for defenses to detect and intercept because of their small size and ground-hugging flight path, and their large numbers can inundate defenses. They are also extremely accurate—exploding within 30 meters of a target—and their 200-kiloton warheads could destroy most "hard" Soviet military sites. And, as with penetrating bombers (but not ballistic missiles), aircraft loaded with cruise missiles can take off from airfields on warning of an attack and then be recalled, without committing the United States to war.

An even more accurate and flexible version of the missile known as the advanced cruise, which makes heavy use of stealth technology, is now being developed. Once deployed on B-1B and B-52 bombers in the 1990s, these missiles should be virtually impossible for Soviet defenses to stop.

Cruise missiles not only render the B-2 unnecessary but are also much cheaper. The ALCMs now in service have cost a total of about \$4 billion, and the new advanced cruise missiles are expected to cost about \$7 billion—one-tenth the price of the B-2 program. Since the missiles would be launched from outside the reach of Soviet defenses, there is no need for extremely sophisticated, expensive aircraft to carry them.

Despite the advantages of the cruise missile, the Air Force—long identified with the penetrating bomber—has resisted efforts to fully incorporate it into the arsenal. In the early 1970s, the

point out that canceling the project could put the prime contractor, Northrop, out of business, along with some 30,000 workers who have already been

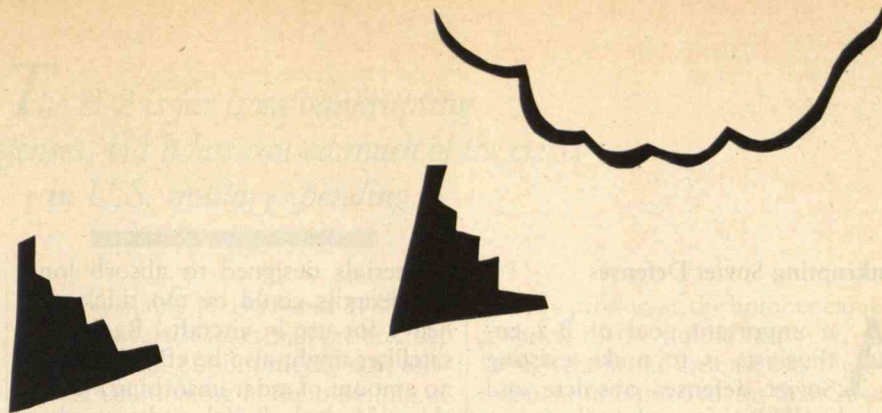
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day accurate and reliable long-range missiles have eliminated the need for pilots to fly along with the bombs.

The first challenge to the penetrating bomber's role came in the late 1950s, when President Eisenhower canceled production of a costly new bomber, the B-70, because of the imminent deployment of cheaper and faster intercontinental ballistic missiles (ICBMs). This forced the Air Force to continue using B-52s, which eventually shared equal





Air Force insisted on limiting the range of the weapon so that it could not reach all parts of the Soviet Union from outside its borders. The program finally had to be placed under Navy control to ensure that it would be completed. Even now, ALCMs are mostly relegated to the secondary—and wasteful—role of destroying Soviet defenses to clear a path for penetrating bombers.

#### Planning to Fight a Nuclear War

**T**he Air Force, of course, has outlined specific missions for the B-2 that cannot be handled by cruise missiles, but they are dubious. The most important is to hunt down Soviet mobile ICBMs and command centers (known as “strategic relocatable targets”) that might survive an initial nuclear exchange. The Soviet Union began deploying the truck-mounted SS-25 ICBM in 1986, and the rail-borne SS-24 ICBM last year. The Pentagon expects the Soviets to mount up to half their ICBM warheads on mobile launchers by the mid-1990s.

However, it is doubtful that the B-2 would be effective against mobile targets. Trees and rough terrain, simple camouflage, decoys, and the targets’ own stealth technology could foil efforts to detect them. Clouds and bad weather would block the B-2’s infrared and optical sensors unless the aircraft flew at a very low altitude, where the sensors’ range would be limited. And if the bomber used radar to search in any weather, Soviet receivers known as “emitter-locators” could quickly locate the radar’s emissions, thus nullifying much of the aircraft’s stealthiness.

Just as important, the subsonic B-2 would have no more than a few hours to find its targets, and could not return for more missions, since airfields in the United States, Europe, and Asia would probably not survive a nuclear exchange. The bomber would almost certainly have to rely on information from reconnaissance satellites to narrow its search area quickly. But Soviet antisatellite weapons could destroy U.S. satellites in a conflict, and Soviet transmitters could jam space-based radars with noise.

The Air Force itself all but confirmed this view last November, when chief of staff Gen. Larry D. Welch admitted that mobile targets would be but a small part of the B-2’s mission. He added that “the whole business of locating mobile missiles . . . is a very complex task, and we’re a long way from having decided that we know how to handle that task.” The joint chiefs also retreated in their most recent posture statement, saying that the B-2 would present only “an increased threat to some relocatable targets.” Even the Reagan administration’s last budget request cut two-thirds of the funds for the Air Force’s Relocatable Target Capability Program, which is intended to develop sensors to enable the B-2 to locate mobile targets.

Air Force officials also claim that the stealth bomber could be effective against “super-hard” targets buried deep underground—principally Soviet leadership and command shelters. The B-2 could deliver a larger bomb with somewhat higher accuracy than missiles, and would thus need fewer weapons to destroy the same number of targets. But this argument collapses on

economic grounds: the B-2’s enormous cost would more than outweigh the marginal numerical advantage.

By favoring the B-2 for this mission, the Air Force may actually be trying to take advantage of an arms-control loophole. Conferees at the strategic arms reduction talks (START) in Geneva have agreed to count bombers carrying gravity bombs or short-range missiles as one weapon, but to count bombers carrying cruise missiles as several weapons (probably 10). These artificial rules—a Soviet concession to the United States, which favors bombers—let the Air Force load penetrating bombers with more weapons than it otherwise could. Such an advantage would be especially important under a START treaty that cut the Soviet and U.S. arsenals by 50 percent.

The most disturbing aspect of the B-2’s missions is that they have little to do with preventing a nuclear war and much to do with fighting one. Pentagon officials often state that penetrating bombers offer greater flexibility than missiles, allowing the Air Force to respond to changing circumstances. For example, the bombers could ignore targets that had already been destroyed or strike targets missed during an initial nuclear exchange. But these tasks play a role in scenarios of a limited and prolonged war. The proper role of nuclear weapons is to deter war, and for that job ICBMs, SLBMs, and cruise missiles are more than adequate. Indeed, threatening Soviet mobile ICBMs and command shelters with B-2 bombers might only encourage Soviet leaders to fire their missiles early in a conflict to avoid the risk of losing them entirely.



## Bankrupting Soviet Defenses

An important goal of B-2 enthusiasts is to make existing Soviet defenses obsolete and force the USSR to invest heavily in new ones, preventing them from building more tanks or missiles. Estimates of the total Soviet investment required to defend against the bomber have ranged as high as \$500 billion, though no one has provided evidence to support this figure.

But this reasoning is flawed in several respects. First, U.S. cruise missiles have already rendered existing Soviet defenses largely ineffective—and the advanced cruise missile will make this even more true. Second, the Soviet Union has never tried to make its defenses perfect, and there is no reason to believe that it would bankrupt itself to do so in the future. And third, experience suggests that Soviet spending on defenses is relatively insensitive to changes in the U.S. bomber force. Pentagon figures show that the Soviet budget for operating and

(Materials designed to absorb long wavelengths could be too thick and heavy for use in aircraft.) Radars on satellites might also be effective, since no amount of radar-absorbing material could hide the B-2's broad wing when viewed from above. Another possibility is bistatic radar, in which widely scattered ground-based radar transmitters and receivers could detect the aircraft as it flew between them. The Soviet Union might even decide to mount extremely powerful radars and other sensors on dirigibles.

Each of these potential defenses has disadvantages, and the Soviet Union might not want to use them throughout the country. But some might be practical around highly defended sites such as leadership shelters.

## Cost and Management Problems

If the B-2 program is far from bankrupting the Soviet defense budget, it can be blamed for a significant

aircraft from 48 per year planned three years ago to 36 today, and F-16 production has been cut from 216 to 150 per year.

The price of the B-2 program can be expected to rise in the future: the program has already logged \$4 billion in overruns in the R&D phase. To make matters worse, the Air Force intends to produce a number of aircraft before testing is fully complete. This policy, called "concurrency," is intended to save money in a low-risk program, but it can be disastrous in a high-risk venture where major problems are likely to crop up. This was the lesson of the B-1B bomber, which began operating before deep flaws were discovered in its electronic defense systems.

The B-2's innovative design, so far unproven, will require extensive testing. For example, the aircraft's unconventional aerodynamic controls (there is no vertical tail or rudder) could make it hard to fly. The "fly-by-wire" computer-control system, needed to compensate for these difficulties, is far more sophisticated than any yet developed. The aircraft is made of composite materials never applied so extensively in such a large aircraft; structural failures could occur. And only full-scale tests will determine whether radar and other sensors can actually detect the bomber.

Northrop's difficulties with the MX guidance system do not inspire confidence that it can manage such complex projects. (About half the deployed MXs have not been working at any given time, and test missiles have had to be cannibalized for parts.) Former employees of Northrop have sued the company for fraud on the B-2, claiming that engineers sat around with nothing to do while the government paid for their time. Robert Costello, undersecretary of defense for acquisition, returned from a plant visit last spring so disturbed with Northrop management that he proposed canceling the program. The Defense Acquisition Board overruled him, and Pentagon officials now claim that the management issues have been resolved.

modernizing air defenses has remained fairly constant at about \$15 billion for 20 years, despite the deployment of cruise missiles and B-1B bombers.

The B-2 might actually prove vulnerable to unconventional defenses that could be cheaper than \$500 billion. In fact, the Pentagon is studying several of these as a hedge against future Soviet stealth bombers and cruise missiles. For example, long-wavelength radars, although not very accurate, might work when combined with other radars.

share of the crisis facing U.S. military spending. The stealth bomber was born in a period of flush budgets and a rapid arms buildup. Today the nation cannot afford to build it without a significant drain on other defense programs. The B-2's 1990 allocation of about \$4 billion is about half the requested budget for procuring combat aircraft (\$8.4 billion), and one-fourth the requested budget for all aircraft (\$18 billion). Strains on Air Force funds have already slowed production of the F-15 fighter



*The B-2 is far from bankrupting  
Soviet defenses, but it has caused much of the crisis  
in U.S. military spending.*

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Northrop's problems may result from rapid growth. Its annual sales more than tripled between 1980 and 1988, rising from less than \$2 billion to about \$6 billion. Much of that growth can be attributed to the B-2 program, so canceling or even delaying it would devastate the company. It could also have a severe impact on employment in some communities, since Northrop and its principal subcontractors have already hired over 30,000 people to work on the B-2. This fact is likely to weigh heavily on members of Congress when they vote on the military budget.

#### Secrecy as Policy

How did the B-2 program reach this stage without significant debate in Congress? The overabundance of military funding during the last decade, and the B-2's identification as a "Democratic" bomber, have contributed, but one of the main rea-

sons is secrecy. Classification has kept information out of the hands of a potentially critical public and limited congressional debate over the bomber.

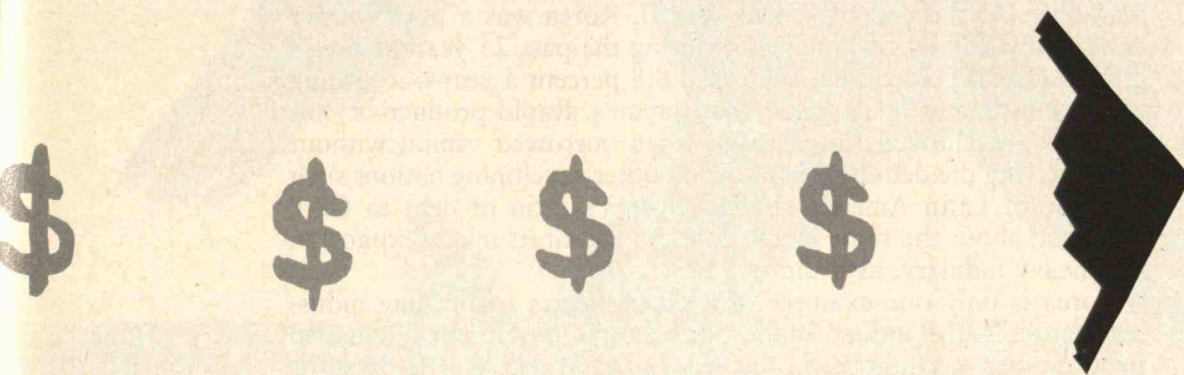
sons is secrecy. Classification has kept information out of the hands of a potentially critical public and limited congressional debate over the bomber. For much of the 1980s the Pentagon was willing to admit only that the project existed. This secrecy began to lift slightly in 1986, when Secretary of Defense Caspar Weinberger had to give Congress an estimate of the program's total cost—then \$36.6 billion. But that figure was in 1981 dollars, and the Pentagon was already aware of substantial cost overruns. More information be-

came available in 1987 and 1988, including an artist's sketch of the bomber and updated (but unofficial) cost estimates, culminating in the unveiling of the bomber last November. But even now such mundane details as the B-2's yearly budget and production schedule remain classified. This pattern is becoming increasingly common for the Air Force. Some 35 percent of its procurement budget is "black," compared with less than 5 percent for the Army and Navy. About 37 percent of the Air Force R&D budget is also classified, compared with 28 percent for the Navy and 17 percent for the Army. Pentagon officials argue that secrecy is needed to protect sensitive technologies, particularly with stealth. (The advanced cruise missile is a black program, for example.) But it is not clear why details such as the programs' budgets should be kept confidential.

A more persuasive explanation is that

price of producing the bomber came as a shock to the public last year, even though the actual increase over the 1981 estimate amounted to less than 20 percent after inflation. Secrecy has annoyed the normally pro-military defense press, which has repeatedly called for declassifying the program. And no strong public constituency has formed around the program since the Pentagon has not revealed which districts receive B-2 funding. This is in sharp contrast to the B-1B program, which was famed for having contracts in nearly every state.

Secrecy also carries technical and engineering risks. The B-2 program is heavily compartmentalized, so that one engineering team often may not know what another team is doing, and even senior managers may not fully grasp all aspects of the program. Peer review is limited, and no outside critics keep program managers honest. These drawbacks may have affected the advanced cruise missile, whose serious problems



in flight testing have delayed deployment.

The ultimate fate of the B-2 is now anybody's guess. Congress should cancel the program. But the more likely course—one supported by House Armed Services Committee chair Les Aspin (D-Wisc.)—is to stretch out the program and possibly cut the total number of bombers produced. Such a solution could increase the price of each bomber by as much as 50 percent—and add little to our security in the process. ■

secrecy is intended to give the B-2 an advantage in budget debates. Until now this strategy has probably been effective, as it has restricted debate to the armed services and appropriations committees, whose members tend to be pro-military and who have little incentive to fight classification (they have clearances). Secrecy has also distracted Pentagon critics, who have focused their attention instead on more visible programs.

Still, B-2 proponents are finding that secrecy can have drawbacks. The total

in flight testing have delayed deployment.

The ultimate fate of the B-2 is now anybody's guess. Congress should cancel the program. But the more likely course—one supported by House Armed Services Committee chair Les Aspin (D-Wisc.)—is to stretch out the program and possibly cut the total number of bombers produced. Such a solution could increase the price of each bomber by as much as 50 percent—and add little to our security in the process. ■



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BY ALICE H. AMSDEN

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# Asia's Next Giant

## How Korea Competes in the World Economy

**J**UST as the American public has started getting used to the idea of Japan's economic preeminence, a new competitor has appeared on the international scene. During the past decade, the Republic of Korea has become a major player in a variety of key manufacturing industries such as steel, automobiles, and consumer electronics.

The rapid growth of Korea's industrial economy has been remarkable. At the end of World War II, Korea was a poor former agricultural colony of Japan. But during the past 25 years, Korea's gross national product has increased 8.8 percent a year—according to some estimates, even faster than Japan's. Rapid productivity increases have allowed Korea to grow on borrowed capital without encountering the debt problems facing other developing nations such as those of Latin America. Indeed, Korea's ratio of debt to GNP remained about the same in 1979, at the end of its major expansion into heavy industry, as it did in 1973.

Korea is only one example of a phenomenon I call "late industrialization"—the unique mode of economic development pursued by a number of countries in the years since World War II. Japan is probably the most famous late industrializer; Taiwan is another example. And while they have not performed as well, the economies of Brazil, Mexico, India, and Turkey also fit the pattern.

There is a tendency in the United States to assume that Korea has

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*Korea is the exemplar  
of a new form of economic development:  
"late industrialization."*







*In Korea, salaried engineers are the gatekeepers for foreign technology, responsible for improving productivity and quality.*

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succeeded because it embraces free-market principles. But that perspective applies an outmoded economic model to what is actually a new form of industrial development. Late industrializers have devised an original approach to productivity, international competition, and the role of government in economic life, derived from the fact that they are unable to compete on the basis of novel technology.

Established industrial nations such as Great Britain, the United States, and Germany grew by creating new technology. Late industrializers are too poor to develop technologies of their own, so they borrow them instead. Bit by bit, they learn how to improve existing products and to make them more efficiently.

At first, late industrializers have to compete in the international marketplace by means of cheap labor. But to achieve the quality necessary for catching up with their competitors, they must actively train workers and encourage them to show initiative. Successful late industrializers have devoted considerable resources to developing a relatively well educated workforce, more so than did other countries in earlier industrializations. In Korea, this has led to rapidly rising wages.

Because low wages are insufficient to compete with the high productivity of advanced countries, government plays a central role. It guides economic development, through a complex web of subsidies, incentives, and disincentives. In fact, what distinguishes success stories like Korea from other late industrializers is not freer markets but the ability to define a national industrial policy and discipline businesses to follow it, thus shaping markets to the purposes of national development.

### **Industrializing Through Learning**

The unique characteristics of late industrialization are best seen against the background of earlier approaches to economic growth. The driving force of British industrialization during the industrial revolution was invention. Independent entrepreneurs based in small firms developed new technologies by trial and error, with government playing a minor

role. This is one reason economists of the period, such as Adam Smith, emphasized the importance of laissez-faire.

By the end of the nineteenth century, however, industrialization had entered a second phase. To catch and surpass their British competitors, firms in the United States and Germany not only borrowed their technology but created a whole new approach to international competition. They combined organized R&D and mass production in a process of systematic innovation. This allowed them to commercialize new fields like petrochemicals and electrical equipment. Where entrepreneurs were the key agents of economic change in Great Britain, corporate managers spearheaded industrialization in the United States and Germany. They created and ran large bureaucratic corporations with many divisions. Government played a far more active role in encouraging industrialization, particularly by protecting infant industries through high tariffs.

These two early episodes of industrialization did have one trait in common. Whether through invention or through innovation, new technologies played a central role. This is not the case in late industrialization. Countries like Korea industrialize by learning. This is not to say that late industrializers aren't innovative in their own way. The learning is anything but passive.

### **Making the Most of Borrowed Technology**

A late industrializer's first step is to borrow technology from other countries and figure out how to use it more effectively. Small firms study foreign machinery and technical manuals, as well as attend trade shows. Large companies buy technical assistance from equipment suppliers and hire retired foreign engineers as consultants.

Cheil Wool, a Korean manufacturer of worsted woollens owned by the Samsung group, has clearly demonstrated the benefits of this approach. When it was founded in 1954, Cheil was able to start production only with the help of visiting staff from German textile machinery suppliers and consultants from the Japanese textile industry. Company engineers took apart imported textile machinery to better understand how it worked. They experimented with new approaches to production by applying ideas found in the technical literature or in foreign catalogs and by imitating foreign manufacturers. Some even

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served as apprentices in German plants, then returned to apply their expertise to improving production at Cheil.

Within 10 years, Cheil had become the first Korean company with quality standards high enough to use the "all wool" trademark, awarded by an international trade association. In 1969, Cheil became the first Korean textile company to win an "Invention Award" from the government, for patenting seven minor process improvements. In 1970, Cheil established an in-house training institute to educate workers in operations, maintenance, and quality-control procedures. And in 1979, the company founded its own R&D laboratory. By 1983, Cheil was spending almost \$2 million annually on research. In 30 years, the company had made the transition from learner to innovator.

Because borrowed technology is central to late industrialization, firms must concentrate their resources on the shop floor, where the technology is made operational and, ultimately, improved. Thus, the protagonists of late industrialization are neither entrepreneurs nor corporate managers but salaried engineers. These employees are crucial because their

hands-on technical knowledge allows them to act as gatekeepers for foreign technology. Once new equipment is brought into the workplace, engineers are also responsible for training shop floor workers in its use.

Between 1960 and 1980, employment of general managers in Korea only doubled while that of engineers increased tenfold—and the quality of managers assigned to shop floor positions has been high. When the Korean government created POSCO, the state-owned steel company, in 1969, one of the first decisions was to assign the best employees to the production line—even before the first mill was built. Today, all shift supervisors at POSCO are experienced engineers with college degrees. New recruits from

universities have to work all three shifts to become familiar with every operation. And technical offices in each major iron- and steel-making facility provide hands-on assistance to line managers. Other Korean firms have similar procedures. At Hyundai Motors, for instance, all new foremen also must have college degrees.

To make sure enough trained personnel are available, Korean society has invested heavily in education. The country excels in most measures of education, standardized for population size. For instance, Singapore's population has long had the reputation of being highly educated. But there are more scientists and engineers per capita in Korea than in Singapore—22 for every 1,000 people versus 5.2. And the high-school attendance rate is greater—68 percent, versus 57 percent in Singapore.

Korean teachers also enjoy relatively high status. In a country long dominated by its military, the base salary of beginning college professors in 1983 exceeded that of army majors. One result of this focus has been an abundant supply of engineers and stiff competition for the best jobs and promotions, which has also helped improve productivity.



*Successful late industrializers devote considerable resources to worker training.*

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In most late industrializing countries, the same corporate structure predominates: the diversified business group. One reason is that firms in these countries do not have the technical or marketing expertise to move into one high-quality market niche, so instead they move into the bottom end of many different markets.

In Korea, these groups are known as *chaebol*. Some examples are Hyundai, Samsung, Ssangyong, and Lucky Goldstar. A *chaebol* is typically owned by a single family and has subsidiaries in a wide variety of unrelated industries.

Such groups are extremely large and account for an unusually high share of GNP. According to one estimate, the top 10 *chaebol* in 1984 accounted for as much as 67 percent of Korean GNP. *Fortune's* list of 500 international, private, non-oil-producing firms in 1986 included 10 from Korea and only 7 from all other developing countries combined.

Despite their diversified structure, the *chaebol* are more centrally coordinated than the typical American conglomerate. This too is a feature of late industrialization. Because the *chaebol* could borrow capital and technology from abroad, they have not had to dilute financial ownership by providing new investors with equity. Since one family dominates at the top of the organization, there are close connections among all the various businesses in the group. In fact, central coordination linked to broad diversification may be a unique competitive advantage of late industrializers, for it allows firms to enter new industries quickly and efficiently.

Surprisingly, centralized management has not led to elaborate hierarchies. According to a study at the Business School of Seoul National University, Korean firms with 5,000 employees or more have even fewer levels of hierarchy than firms with 200 to 300 employees. During the past 30 years, the ratio of managers to blue-collar workers in Korea has actually declined—from 1.3:10 in 1960 to 1:10 in 1980. During the same period, the ratio in the United States increased.

### **Low Wages but Rapid Wage Increases**

Low wages and harsh working conditions are another key component of late industrialization. Korea has one of the longest workweeks in the world. At POSCO, the normal workweek is seven 8-hour days. Workers are entitled to only one day off per month.

Korea also has the dubious distinction of being the nation with the widest gap in wage rates between men and women (with the possible exception of Japan). On average, women earn less than half as much as men.

Among the factors that have kept wages low in Korea are high population growth and the absence of opportunities for emigration. Both have created an expanding labor supply. Also, Korean companies and the government have been extraordinarily hostile to unions. For 20 years, government labor policy was effectively in the hands of the Korean Central Intelligence Agency, and until recently anti-labor provisions were written into law. In addition, Korean industry has never had large numbers of high-skilled craft workers, who have been the backbone of unionization efforts in other countries. Both these factors have delayed the creation of a strong labor movement.

But while competition on the basis of low wages was necessary to begin the late-industrialization process, low wages alone do not guarantee success. Training workers to produce quality products has proved equally critical. When the Hyundai Shipyards first began building ships in 1973, managers treated quality as a low priority. But as customers, inspectors, and insurance companies began pointing out defects in Hyundai ships, more attention was paid to teaching workers how to manufacture quality products.

At first, the company established stringent quality standards and procedures. But managers found that workers did not have the skills to follow the new procedures and to meet the tougher specifications. So they set up a system of regular quality meetings, which by the end of the decade had evolved into a system of formal "quality-control circles." They also organized a small training center where supervisors would go for one to three months to learn quality-control techniques. In 1978, the center set up qualifying courses for Hyundai welders, fitters, pipers, and painters. Beginning in the late 1970s, quality at the shipyards began to improve. By 1983, Hyundai had won quality-assurance certificates from organizations such as Lloyds of London and the American Bureau of Ships.

Korea's contradictory combination of harsh labor conditions on the one hand, and the need for motivated, well-trained workers on the other, has recently led to increased labor unrest and rising wages.





In fact, average real wages—which have grown at 9.3 percent a year between 1965 and 1984—are increasing faster in Korea than in perhaps any previous industrialization, including that of Japan. What's more, the strikes that have erupted in Korea since 1987 have in some cases led to precedent-setting labor agreements, such as the one between Korean unions and Hyundai Shipyards. Thus, contrary to popular stereotypes, Korea does not build its excellent economic performance solely on the brutal exploitation of workers.

### Disciplining Big Business

Perhaps the most important trait of late industrialization is active government intervention in the economy. Governments in these countries have created a network of public subsidies to stimulate exports, encourage economic growth, and reward favored firms.

Some forms of intervention are more effective than

others. To succeed, a government must be able to discipline the private sector and shape the activities of big business. In Korea, government subsidies are not giveaways. In return for them, recipients must adhere to stringent performance standards. This way, subsidies are less bountiful but more effective.

Some government subsidies take the traditional form of protectionism. Tariffs and quotas have protected the Korean market from competitive imports. Indeed, the Korean automobile industry had no foreign competitors for more than 20 years.

But intervention extends far beyond simply protecting infant industries, as the United States and other countries did at the turn of the century. The Korean government also controls the banking system. During the 1950s, under pressure from the U.S. Agency for International Development, Korean President Syngman Rhee privatized his country's financial system, which had been nationalized under the Japanese. After a coup in 1961, one of the first actions of the military regime that took power was to renationalize the banking system.

The Korean government also had to guarantee repayment of foreign loans to Korean companies, which gave it the power to allocate these loans. The government targeted them to specific industries and firms, while less-favored borrowers had to pay higher interest to domestic state-owned banks, or borrow money privately at even higher rates.

This system of multiple interest rates is important for shaping the forces of supply and demand. The price of foreign loans, in particular, was heavily subsidized. The combination of relatively fixed exchange rates, domestic inflation, and the rapid depreciation of Korean currency meant that Korea actually paid no interest on its loans from foreign countries during the two critical growth decades of the 1960s and 1970s.

The Korean government also limits market entry in particular industries to those firms it chooses to support. To enter a market, a company must be licensed by the government. By limiting entry to only a few firms, the government uses these licenses to reward its friends. Typically, the government licenses at least two firms per industry to encourage competition. To further curb monopoly power, the government negotiates yearly price controls. In 1986, as many as 110 commodities were controlled, including flour, sugar, coffee, red pepper, electricity, gas, steel, chemicals, synthetic fibers, paper, drugs, nylon



stockings, automobiles, and televisions.

The government also sets export targets. These are used not just to drive industrialization forward but to keep big business in line. They are an informal standard by which to judge a firm's performance. Exporters have been eligible for subsidized working capital, tax breaks, and other benefits. Favored firms in targeted industries have also been the recipients of long-term loans for capital investments and other forms of government support.

When badly managed firms in otherwise healthy industries fail, the Korean government has often refused to bail them out. In the 1950s, a company called Shinjin had a larger market share in the Korean automobile industry than Hyundai Motors. However, Shinjin couldn't survive competition from Hyundai's successful "Pony" model and from the oil shock of the 1970s. The company went bankrupt, and the government transferred Shinjin's holdings to Daewoo Motors. In the cement industry, the largest producer in the 1970s went bankrupt because it tried to optimize an old technology rather than switch to a new one. Its production facilities were transferred by the government to the Ssangyong group, a big business owned by one of the ruling party's elders. The Taihan group, a pioneer in the electronics industry, had an ailing consumer electronics division that failed. Eventually, the government oversaw the division's transfer to Daewoo Electronics.

Beyond rewarding or punishing individual firms, the government often influences entire industries. In the 1960s, for example, government officials decided that the Korean textile industry was using too much foreign exchange to import raw cotton. They reasoned that a textile industry based on synthetic rather than natural fibers would be not only more economical but more competitive, because it is easier to control the quality of synthetic textiles. So the government subsidized privately owned factories to produce synthetic fibers. Likewise, to make the Ko-



rean electronics industry more competitive in the 1980s, the government sponsored some 182 joint research projects involving private-sector R&D labs and public research institutes.

The government has also shielded the Korean economy from domination by foreign investors. A web of legal restrictions has traditionally made it difficult for foreigners to own companies—unless the companies make products for export. As a result, Korea has incurred large amounts of foreign debt, but foreign equity investment is relatively insignificant. Korea has industrialized largely on the basis of Korean firms.

Likewise, there are strict controls on capital flight. Legislation passed in the 1960s stipulates that any illegal overseas transfer of \$1 million or more is punishable by a minimum sentence of 10 years in prison. The maximum sentence: death. These harsh terms have been a deterrent to private investors in the 1960s and 1970s who might otherwise have used public subsidies to build personal fortunes abroad.

Of course, all these mechanisms for punishing and rewarding big business are highly politicized—the ruling party in Korea tends to reward its friends. But



## *The Korean government subsidizes businesses that adhere to national industrial policy and punishes those that do not.*

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this does not mean that the Korean government is subsidizing inefficiency. In fact, those firms most favored by the government are some of the most efficient in the country. And even when a particular *chaebol* is corrupt at the top, the predominance of skilled salaried engineers at its subsidiaries tends to insulate them from any negative effects. For instance, during the same period that Cheil Wool was perfecting its business, the head of the Samsung group that owned the company was being prosecuted by the government for corruption.

### **What Makes the Korean State Strong?**

Why is it that some late industrializers have strong governments and others do not? The answer has to do with history. In Japan, the state has been a strong centralized power for the past four or five centuries. In Taiwan, the mainland Chinese elite that has controlled the government since 1949 represents an entrenched occupying force. And in Korea, the past 30 years have witnessed the transformation of a weak central government into a strong one.

This was possible, in part, because there was no coherent opposition in finance, industry, or agriculture. The government controlled the banks, so there were no sources of financing to challenge its will. Because industry evolved in a government-subsidized hothouse, corporations did not have a history of independent existence—as they have, say, in Turkey and India—or the independent identity that comes with it.

Most important, Korea in the late 1940s underwent a land reform prompted by the U.S. occupying forces. This created a system of small landowners who never had the power to compromise the state's authority. The coffee estates of Brazil and the big landowners of India have no political equal in Korea. It is no coincidence that the three most successful late industrializers—Japan, Korea, and Taiwan—all experienced land reforms after World War II.

The state, in turn, has shown a fair amount of discipline. One important reason has been the strength of Korea's student movement. Korean students have been an extraordinarily active political force from the earliest days of Japanese colonialism in the 1870s. As learning has become central to Korean industrialization, Korean students have mobilized popular support to keep the government honest. In fact, the militance of students and workers

has been the main force pushing Korea toward a more democratic political life.

Korea belies the stereotype that links government intervention and big business with dictatorship, and free markets and small firms with democracy or superior labor conditions. Recent political developments indicate that Korea may yet find a way to combine government intervention and big business with a more democratic political life.

### **Overtaking the Developed World?**

The success of late industrializers sometimes obscures the fact that these countries continue to face serious economic challenges. More advanced economies threaten them from above with new technological innovations, while less advanced countries threaten them from below with even lower wages. Late industrializing countries cannot stand still.

Korea is investing large amounts of money in technical education and R&D. Between 1976 and 1986, the number of engineering graduates with advanced degrees increased sevenfold. R&D was only 0.39 percent of GNP in 1970; by 1986 it had reached 2 percent, even as GNP soared. According to government plans, R&D spending will rise to 2.8 percent of GNP by 1990 and 5 percent by the year 2000. Current levels in advanced industrial countries are only 3 to 4 percent.

By the late 1970s, all the biggest *chaebol* had opened R&D laboratories in their major industries. As the government has systematically reformed tax credits and raised incentives to encourage R&D, the number of laboratories has risen—from 3 in 1967 to 138 in 1984. Such labs are often headed by Korean-Americans with practical R&D experience in the United States.

Korea seems not only to be retaining the traits that have allowed it to industrialize so rapidly, but also to be developing the R&D base that characterizes more advanced industrial countries like the United States. If this trend continues, Korea will become an even more formidable competitor. Japan is already an important source of new technology. Korea, Asia's next giant, is not far behind. ■



*Remote sensing  
allows archeologists  
to investigate  
sites without  
destroying them.*

# Revealing the Ancient World through High Technology

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BY VICTORIA  
AND  
DALE LIGHTFOOT

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**A**s they investigate ancient cultures,

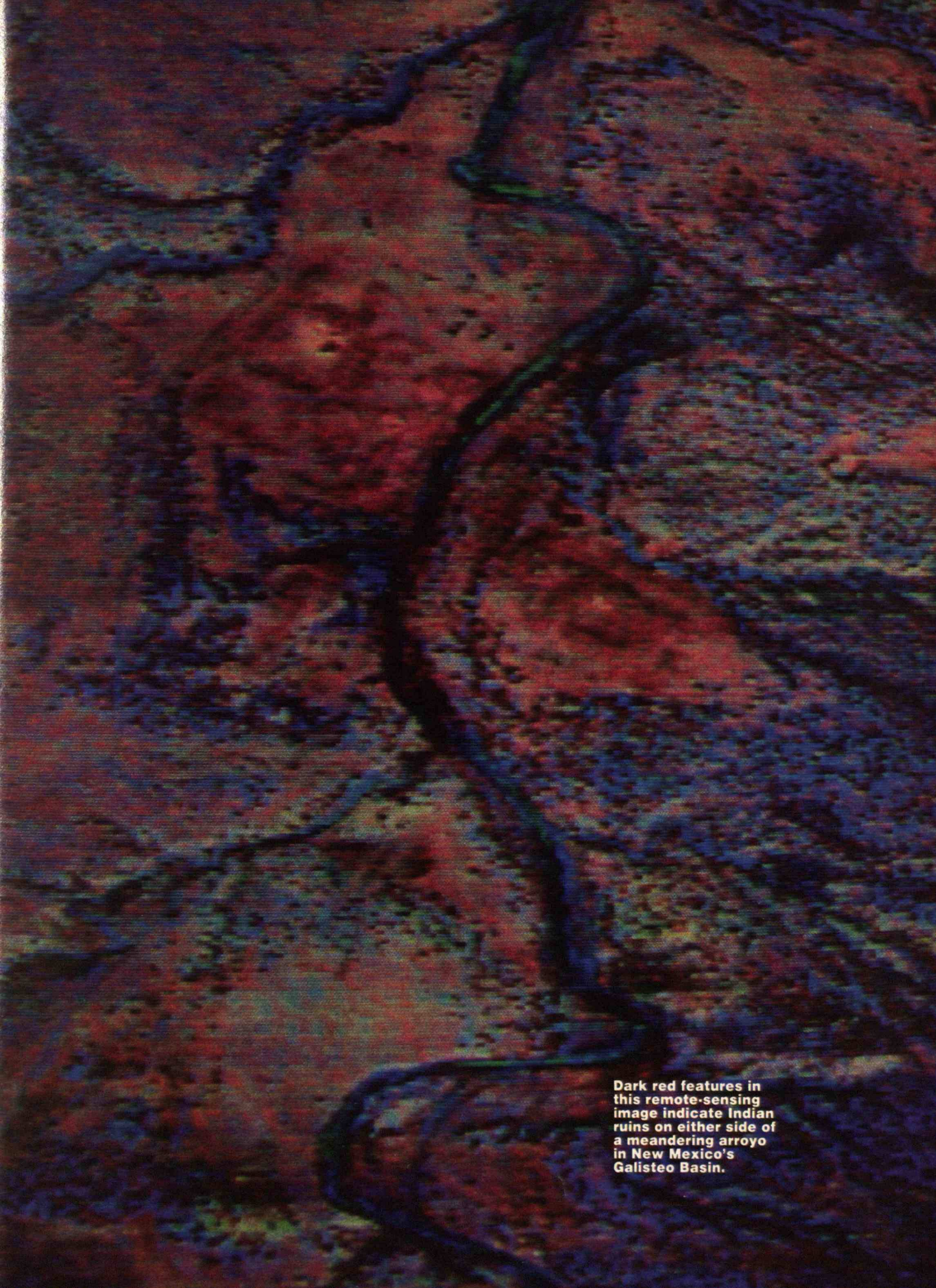
archeologists often try to locate features such as dwellings, agricultural fields, and footpaths. Sometimes the task is daunting. How could anyone hope to find footpaths used 1,000 years ago, for instance? But remote-sensing technology has enabled teams to do just that near the Arenal volcano in Costa Rica. They have found the paths using a form of aerial photography known as color-infrared photography (CIR). That technique reveals—through the use of near-infrared wavelengths of light—subtle stresses to plant life that can't be seen by the human eye. At the Arenal site, strips of stressed plants indicate the location of the compressed soil of ancient pathways.

Today, archeologists can use remote-sensing technologies such as CIR, heat-detecting infrared scanners, and ground-penetrating radar to help locate ancient features that are difficult to see or out of sight. Remote sensing is also valuable for producing maps that are more accurate than the rough, often incomplete sketches traditionally made by pacing off distances.

The ability of maps produced by remote sensing to cover entire regions makes them useful to the increasing number of archeologists who have adopted a broad landscape approach. They recognize that looking at ancient agricultural fields, road networks, and other features that link settlements is just as important as documenting the aspects of single dwellings. Past attempts to work with such an approach involved merely plotting sites on U.S. Geological Survey topographic maps, whose scale was usually too small to accommodate all the details. But remote-sensing images show everything on the ground. For example, University of Colorado anthropologist Frank W. Eddy is using imagery that shows 500-year-old village-sized dwellings, agricultural fields bordered with stones, and outlying farmhouses on two 2-by-20-mile strips of land south of Santa Fe, N. Mex.

Remote-sensing technologies are also of great value in salvaging archeological information before





Dark red features in this remote-sensing image indicate Indian ruins on either side of a meandering arroyo in New Mexico's Galisteo Basin.



areas are lost to development. When researchers have time to excavate only about 1 or 2 percent of a site, remote-sensing images can help them quickly decide where to dig. Notes archeologist Mike Corkran of the Army Corp of Engineers, "You may not get a second chance at a site, and therefore it becomes critical to get it right the first time."

Perhaps the best advantage of remote sensing is that it can be used to avoid most excavation. Digging—which systematically destroys at least some of the remains—is becoming taboo, since a site can't be replaced afterward. In part, archeologists are starting to realize that in the future they may want different information from a site. And they are increasingly concerned about preservation for its own sake.

### Airplane Archeology

A remote-sensing tool that has long been part of archeologists' repertoire—aerial photography—continues to be an important technique, as well as providing the basis for many of the new techniques. Photos taken from airplanes can be used as maps on which additional information can be plotted. Because many organizations, both governmental and private, have libraries of aerial photographs, they are relatively inexpensive, sometimes even free, and easy to obtain. They also are fairly simple to interpret.

In the summer of 1987, the University of Colorado's Frank Eddy used large-scale black-and-white aerial photographs to explore a significant archeological site near Chimney Rock, Colo., that was colonized by the most highly developed of prehistoric North American cultures. Before even stepping into the field, he had accurately mapped two-thirds of the housing structures built there between A.D. 900 and 1000 by the Anasazi. This culture has lived in the four-corners area of Colorado, Utah, Arizona, and New Mexico for the past two 2,000 years, and today constitutes the Hopi, Zuni, and other tribes. The Anasazi used to reside in two types of "pueblos"—large collections of rooms around square central plazas and smaller clusters of rooms in outlying villages. On the aerial photographs that Eddy used, the pueblos appear either as large squares of "room blocks" or smaller circular "house mounds" of earth and rubble.

Aerial photography is also critical for Mike Corkran and his colleague James Ebert of Albuquerque. These archeologists are trying to decide which of a

group of sites along lakes in Texas and Oklahoma are in danger from erosion, which are beyond repair, and which need to be preserved. They are using aerial photos from the 1920s onward to determine how the shorelines have changed over time.

Currently Corkran is studying Haley's Point along the Red River, which runs between Texas and Oklahoma. Researchers working there have found bison and mammoth bones, spear and arrow tips dating from 10,000 B.C., as well as dwellings, storage pits, and human burial artifacts used by Plains Indians from A.D. 1400 to 1500. Corkran is discovering that erosion is claiming as much as 30 feet of land each year—a situation he says he "never imagined before." He wants to find out if enough of the site remains to make preserving it worth the millions of dollars that could be required.

Of course, traditional aerial photography sees only what the human eye sees. Other aerial technologies offer archeologists improved vision. For instance, CIR imagery shows, in shades of red or sometimes green, changes in vegetation so slight that they often aren't noticeable to people in the field. A case in point is the CIR work conducted by Frank Eddy in the Galisteo Basin south of Santa Fe. The images he is using indicate many field-sized rectangular patches of a slightly darker shade of green than the surrounding vegetation. These patches, most of which were previously unknown, have turned out to be 550-year-old agricultural fields that the Anasazi had mulched with pebbles to retain moisture. With the pebbles still in place, the areas continue to conserve water better than the surrounding soil. Therefore they produce healthier vegetation—which shows up darker on CIR film. So far Eddy has located, mapped, and ground-checked 87 pebble-mulched fields surrounding one of the eight major Anasazi settlements in the region. The find is important because it shows the very advanced agricultural level that the Galisteo Anasazi reached.

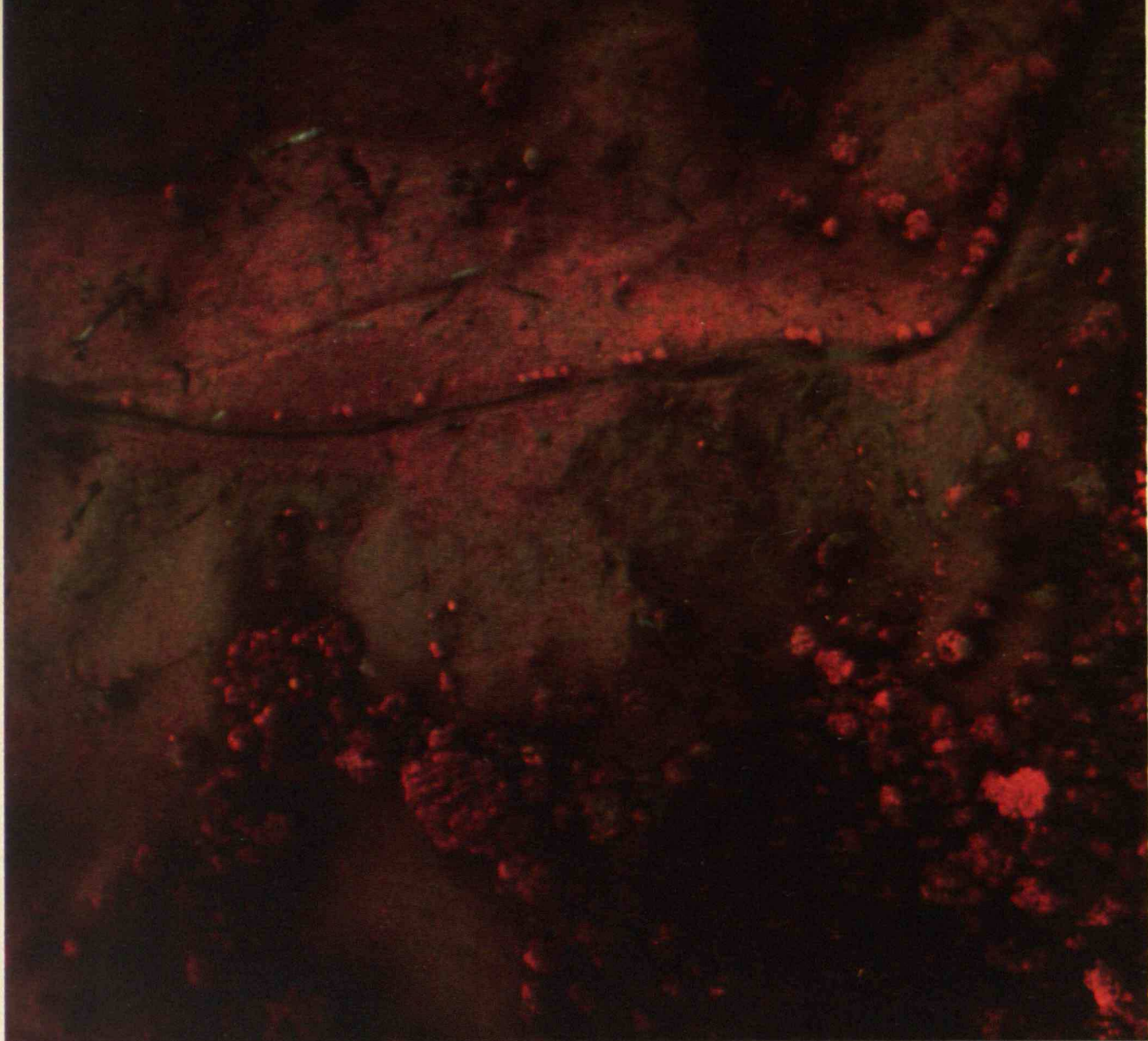
Colorado anthropologist Payson Sheets and NASA archeologist Tom Sever never would have made their remarkable find of 1,000-year-old footpaths around the Arenal volcano without using CIR imagery. The images show a line that bends slightly around a repository of construction stone for a prehistoric cemetery, then divides in two, and heads down to a stream. Originally skeptical, Sheets excavated the area and found cross sections of deeply eroded paths. Since he knew when 10 layers of ash from the nearby volcano were deposited, he could date the earth above and below the paths and determine that they were used in the Arenal culture.

Another technology, the thermal infrared-multi-spectral scanner (TIMS), has proven invaluable for finding remains long buried just beneath the surface. The scanner is also good for seeking out alterations

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*VICTORIA LIGHTFOOT is a free-lance writer and public school teacher. DALE LIGHTFOOT, a doctoral candidate in geography at the University of Colorado, is employing remote-sensing techniques to study prehistoric settlements and land use. The Lightfoots have spent several years tramping among the ancient ruins of North and South America.*





**Above:** Near the Arenal volcano in Costa Rica, archeologists have used a form of remote sensing that shows where plant life is stressed to discover a 1,000-year-old footpath. The path is the faint straight feature slanting upward above the curved line.

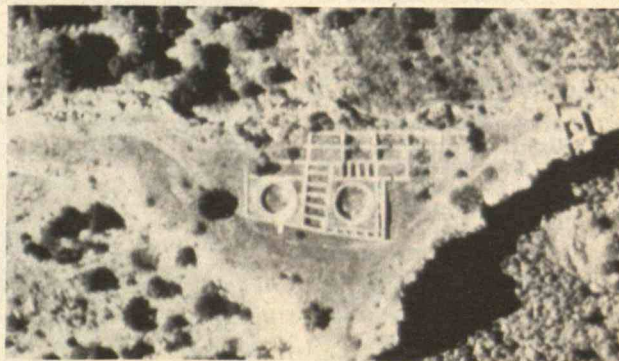
**Right:** To confirm that this feature was a footpath, the researchers dug a trench. Sure enough, they found a depression in the layers of volcanic ash, indicating that people had walked repeatedly on that section.







**Right: An aerial view of a pueblo that University of Colorado anthropologist Frank W. Eddy helped excavate in southwestern Colorado. The people who lived here used the areas within the round walls for religious ceremonies.**







**Above:** Dark green patches in the lower left quadrant of this image of the Galisteo Basin indicate ancient agricultural fields that the Anasazi Indians mulched with pebbles. Since the sites continue to retain slightly more water than their surroundings, they show up on aerial color-infrared photographs.

**Insert:** The same fields are barely visible to the naked eye. Author Victoria Lightfoot walks along the border of one. Another boundary, stretching from the photo's lower left to upper right, is slightly apparent.

of the landscape's surface, especially in areas without much vegetation. TIMS detects heat, and since compressed soil absorbs more solar energy than the looser surrounding earth, compacted features such as old roads show up in lighter, brighter shades than their surroundings.

In 1983, when Sever used TIMS in the dry area of Chaco Canyon in northwestern New Mexico, he found an ancient road network not apparent on CIR images. The TIMS images of the canyon, which was a major trade center for a large group of Anasazi villages occupied between about A.D. 900 and 1100, also indicated subterranean walls, agricultural fields bordered with stones, and pueblo settlements connected by the roads.

**E**ddy is manipulating TIMS images of the Galisteo Basin to enhance contrasts among levels of heat emissions. He is experimenting with a technique called directional filtering, which suppresses background "noise" such as various amounts of heat coming from hills and valleys. Linear features that might indicate ancient roads then stand out on black-and-white versions of the images. So far Eddy has filtered only a small percentage of his imagery of the Galisteo Basin, but he has already found some obviously unnatural features. Of course, researchers will have to survey the site on foot, since power lines, barbed wire, and the like also show up on directionally filtered TIMS images.

A better way to discern features is to enhance TIMS imagery so that heat emissions appear as different colors. Archeologists can use this procedure, called principal-components analysis (PCA), to discriminate among building materials and detect subtle variations in soil disturbance and compaction. PCA has helped Eddy confirm the presence of two Galisteo Basin room blocks that CIR images had previously indicated might be a part of a pueblo. He also has found what looks like room blocks or walls near another Anasazi pueblo at the same site. In the PCA-enhanced TIMS image, the apparent walls are similar in color and hue to the pueblo.

By combining TIMS and CIR, Sever has found and verified 10 archeological features from 1600 to 1000 B.C. at a site where the oldest civilization in North America may have lived. The massive site, called Poverty Point, is located atop a bluff in northeastern Louisiana near the modern town of Epps. Archeologists had already discovered an extensive complex of earthworks surrounding a large central plaza. They also had found caches containing copper, the rock chert, and other materials that seem to have been traded regionally by the Poverty Point culture. Interestingly, researchers who had examined the chert and copper located in Poverty Point with electron microscopes had recognized that the materials correspond precisely to those from certain



ruins in Florida, Michigan, and western states. Sever used remote-sensing images to show how important the caches were to the Poverty Point culture. He found causeways leading to them, which proved that residents had visited the caches frequently.

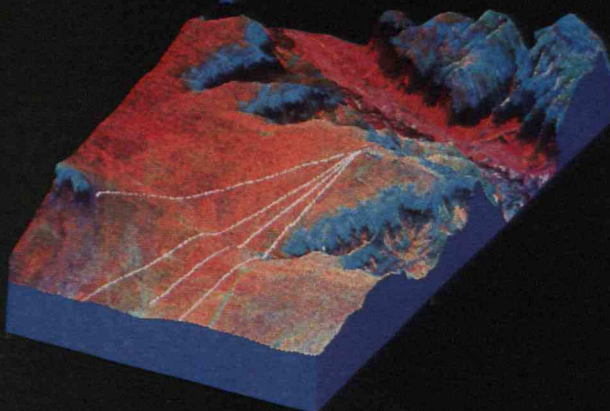
## Remote Sensing from the Ground

Some remote sensing used in archeology depends not on aerial photography but on ground work. To pick up fine details on a site, archeologists can use sleds carrying ground-penetrating radar. The pulses of radio waves sent into the earth as a sled is dragged across the site bounce off buried features such as walls or foundation trenches, creating patterns of echoes that indicate exact locations. Archeologists may also employ thermal resistivity, a technology similar to TIMS except that the instruments are pulled over the ground.

**G**round-penetrating radar and thermal resistivity have enabled Mike Corkran to locate submerged features at Deer Creek, a national historic site on the Arkansas River in Oklahoma, without digging. Nobody—not the state of Oklahoma or the National Park Service, which is in charge of historic sites, or the Army Corps of Engineers, which is directly responsible for Deer Creek—wants to alter the site through excavation. That's because Deer Creek probably represents the earliest European settlement in Oklahoma. Corkran has found the outlines of trenches that may have been used for fortifications in the early eighteenth century when the French and Spanish met at Deer Creek to trade with the Wichita Indians. In addition, he has found postholes that could help define the floor plans of old structures. Corkran points out, "Everything that's going to be known about this site is going to come from some kind of remote sensing."

Remote sensing does have its limitations. With the exception of standard aerial photographs, the imagery has rarely been collected, and it can be expensive and difficult to obtain. For instance, CIR and TIMS instruments must be mounted on moderate-sized jet aircraft such as the Lear, which is quite costly to fly. Moreover, archeologists usually receive little or no formal training in remote sensing. Many of them are also reluctant to use the approach, since they think that their place is in the field.

But libraries of remote-sensing images are growing. And some schools, such as the University of Colorado and Boston University, now include remote sensing as part of the archeology curriculum. Most encouraging of all, today's students are taking to computers more than their predecessors have. By the turn of the century, remote sensing could prove as important to archeologists as the shovel. ■

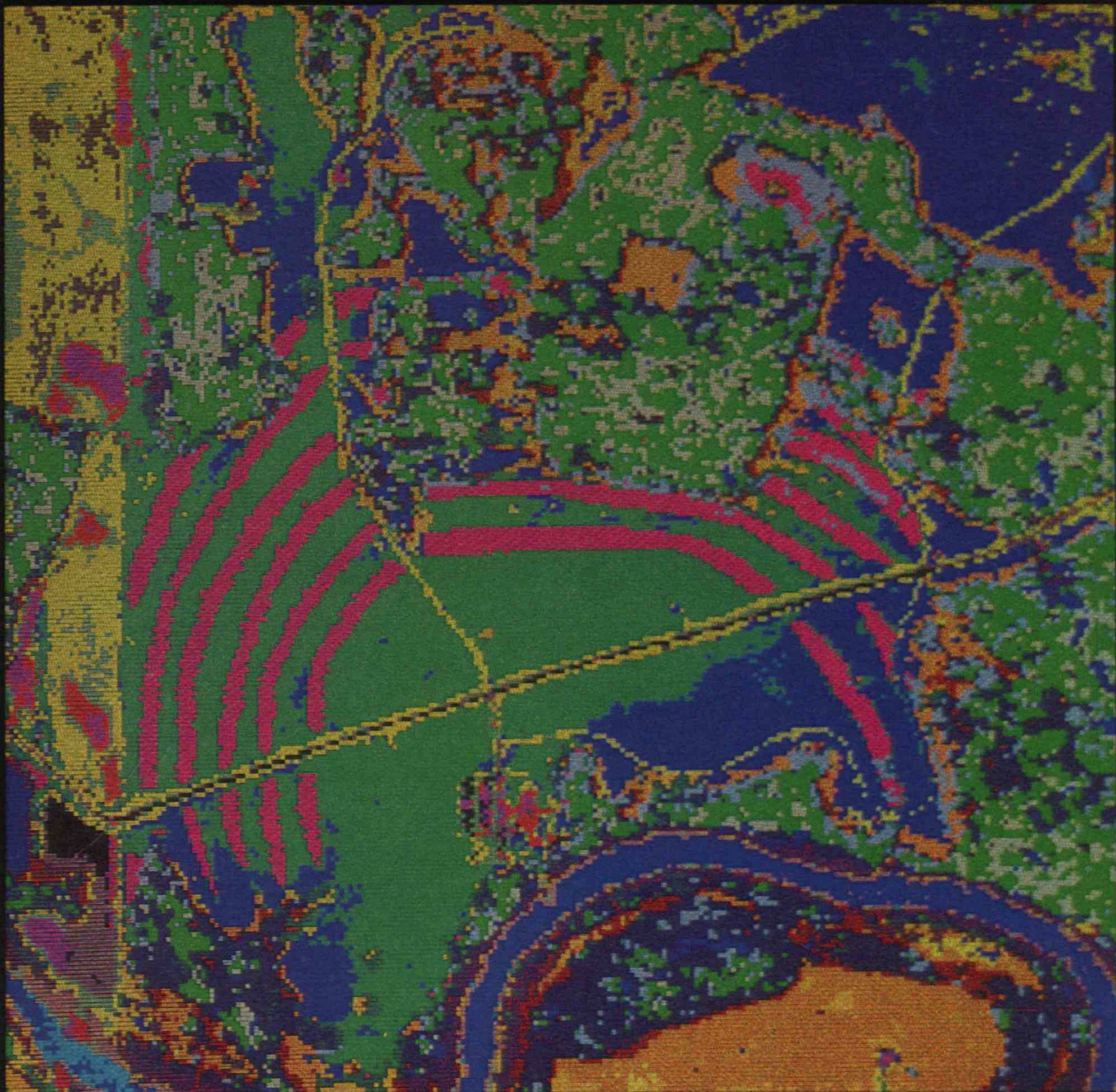


**Above:** Using a computer to manipulate a thermal infrared-multispectral scanner (TIMS) image can make important archeological features stand out clearly. Here white coloring has accentuated three roads used between A.D. 900 and 1100 in Chaco Canyon in northwestern New Mexico.

**Right:** A TIMS image of the Poverty Point site in Louisiana shows the location of housing and causeways used by the culture that lived there between 1600 and 600 B.C. The bright pink concentric features are the remains of mounds upon which ancient housing was built, while the yellow lines crossing them are paths to caches of items that the people apparently traded.

**Right:** Although remote-sensing imagery often consists of aerial views, archeologists sometimes pick up fine details by pulling instruments across a site. These technicians are towing ground-penetrating radar at Chimney Rock in southwestern Colorado.









**War has dominated Nicaragua's environment in the 1980s. This mural depicts Sandinista soldiers leading captured U.S. pilot Eugene Hasenfus through the lush forests near the Costa Rican border.**



# A Casualty of War: The Nicaraguan Environment

BY ROBERT A. RICE

**A**s developing countries desperately try to escape the burden of debt and forestall economic chaos, a common victim is the environment. However, the environment-debt connection is but the latest twist in a long history of ecological degradation. For decades, nations that are economically poor yet rich in natural and human resources have suffered from their partnership with the industrialized world.

Nicaragua provides a case in point. Beginning in the late 1880s, European and North American companies took turns harvesting the nation's mineral, timber, and marine resources, wreaking havoc upon soil, forests, and water. Like other Third World countries, Nicaragua relied on such exports to earn currency to buy items not made domestically.

In 1979, when a popular insurrection ended five decades of dictatorial rule by the

*Nicaraguan  
environmental policy  
could serve as a model for  
Third World countries,  
but only if the contra  
war and the U.S.  
economic embargo  
end.*

Somoza family, the Sandinista government introduced a new environmental ethic, recognizing that sound ecological principles are central to improving the quality of life for all citizens. Ambitious and innovative projects in pesticide regulation, alternative energy, and rain-forest and wildlife conservation promised to revitalize the abused landscape.

But environmental harmony is not easily achieved.

Although the Sandinistas vigorously advocate reforms, they are saddled with a growing debt and a U.S.-sponsored contra war and economic embargo. Nicaragua's short-term economic survival continues to depend on exporting natural resources and agricultural products.

Nevertheless, what Nicaragua has done in the last 10 years sets this beleaguered country apart. With peace, its programs could flourish and serve as models for sustainable development throughout the Third World.





## The Colonial Legacy

Among the first to exploit Nicaragua's wealth of natural resources were the British. In the late nineteenth century, their mining operations invaded the wilderness to expose gold-bearing quartz veins. Later, Canadian and U.S. mining firms moved into the backwater terrain of

the northeast. Small operations that depended on a mercury process to extract gold from ore gave way to larger facilities that used a more efficient cyanide treatment. A Massachusetts-based company introduced cyanide in 1904 in the La Leonesa mine near Matagalpa in northern Nicaragua.

Mining companies in the northeast goldfields eventually cast over 3,700 tons of cyanide into the Río Sucio at Bonanza between 1961 and 1978, according to Nicaragua's Institute of Natural Resources and the Environment (IRENA). Another 435 tons polluted the Río Bambana at nearby Rosita from 1975 to 1979.

*ROBERT A. RICE is a doctoral candidate in geography at the University of California at Berkeley. In 1987 and 1988, he did field studies on the environmental effects of a new coffee technology in southern Nicaragua, and he works with the San Francisco-based Environmental Project on Central America.*



*Under Somoza, Nicaragua led  
Central America in the export of rare plants and animals. As a result,  
many species teetered on the edge of extinction.*

IRENA research suggests that cyanide wiped out several species of fish in the Miranda, Matis, and Sucio rivers in the northeast.

Water quality threatened human life as well. A 1968 World Health Organization study found that contaminated water led to 17 percent of all Nicaraguan deaths. A 1981 IRENA report indicated that 50 percent of the water sources sampled were seriously polluted by sewage, 75 percent by agricultural residues, and 25 percent by highly toxic industrial wastes. Agricultural runoff, sewage disposal, and toxic effluent from 37 industrial plants turned Lake Managua—the second largest freshwater lake in the isthmus—into what was called the “Lake Erie of Central America.” Among the U.S. firms that dumped waste there for years, Hercules Chemical Co. formulated the pesticide toxaphene, and Pennwalt Corp. carried out metal-plating operations. Pennwalt discarded an estimated 40 tons of mercury into Lake Managua from 1968 to 1981.

Nicaragua’s diversity of wildlife rivals that of any nation, with 750 bird species, 600 reptile and amphibian species, 200 mammal species, and 100 species of freshwater fish. But under Somoza, Nicaragua led Central America in the export of rare and endangered species. Many teetered on the brink of extinction, owing to both the unregulated sale of furs and the destruction of natural habitats. White-lipped peccary, white-tailed deer, hawksbill turtles, caimans, freshwater otters, jaguars, ocelots, margays, and lobster were exterminated or extensively depleted.

As in other Central American countries, deforestation also took a toll. Thirty percent of Nicaragua’s forests were wiped out in the 1970s, partly as a result of logging contracts with foreign companies. From 1945 to 1960, the U.S.-based Long Leaf Pine Co. (NIPCO) paid the Somoza family a percentage of its multi-million-dollar business in exchange for favors, such as the option of not replenishing clear-cut pine forests. By 1961, NIPCO had cut nearly all the commercially valuable coastal pines in northeast Nicaragua, denuding over 1,000 square miles.

Even more important, an unequal distribution of arable land lay at the heart of forest destruction. By the 1970s, 1 percent of the population controlled half of Nicaragua’s land. The Somoza family alone owned a fifth of the arable territory. Cash-crop production by large, well-connected landowners took priority over food grown for domestic consumption. The territory devoted to growing cotton increased from about 41,000 acres in 1950 to over 519,000 acres in 1977.

Expanding cotton holdings pushed peasants off fertile Pacific coast plains. Covered with a thick mantle of productive volcanic soils, the area had been called the breadbasket of Central America. Some displaced families moved to the interior, where the production of basic grains soon eroded the fragile hillsides of their thin soils. They moved on, only to repeat the ecologically damaging operation. Other peasants migrated to the forested slopes of the Atlantic region and practiced slash-and-burn subsistence farming on this “agricultural frontier” at the edge of the rain forest. They cleared lush vegetation to plant crops, but the soils were ill-suited to annual cultivation. After a few years of declining yields, the peasants would move on to clear new areas.

According to Nicaraguan economist Jaime Biderman, this environmental destruction served one of Central America’s richest agricultural enterprises. As in Latin America generally, cattle ranching exploded in the 1960s in Nicaragua. Ranchers converted thousands of acres in the Atlantic region to pasture, sometimes seizing land with the help of the National Guard. Beef exports jumped from almost zero in 1958 to \$6.7 million in 1965 and \$26.6 million in 1970. Nicaragua became the number-one Latin American beef supplier for the United States, fueling fast-food chains and pet-food industries.

Meanwhile, cotton growing led to pesticide contamination, Nicaragua’s most serious environmental problem. In the 1960s and 1970s, 40 percent of all U.S. pesticide exports went to Central America. Growers routinely applied DDT, methyl parathion, and Temik to crops. Somoza turned Nicaragua into a living laboratory, allowing chemical companies to test new pesticides for \$1,000 each. In 1951, the West German firm Bayer supplied 12 million pounds of methyl parathion that was applied to cotton fields, causing dozens of deaths and hundreds of illnesses among field workers and their families. The Ministry of Agriculture banned the pesticide, only to have Somoza reverse its decision in 1954.

Unfortunately, pest populations evolved resistance to toxins. To compensate, growers applied higher doses and new products at shorter intervals. By the 1970s, cotton producers around Leon were selecting from 70 different products and spraying 30 to 35 times per season.

Nicaragua, along with Honduras, led the world in pesticide poisonings and deaths in the 1960s and 1970s. A 1977 study revealed that mothers’ breast milk in the



*Although the Sandinistas faced  
monumental economic problems, they quickly initiated  
a bold environmental policy.*

León area contained 45 times the DDT levels deemed safe by the World Health Organization. And DDT found its way into beef exports, threatening U.S. consumers. In 1967, U.S. Food and Drug Administration inspectors blocked the import of 300,000 pounds of Nicaraguan beef with excess DDT, and the U.S. Department of Agriculture repeatedly rejected beef from Nicaragua and other Central American countries.

### **An Environmental Revolution**

In 1976 a small group of Nicaraguan professionals tried to halt the environmental destruction by petitioning the government to create a ministry of natural resources. Somoza not only rejected the proposal but even threatened the group with harsh reprisals if they met again.

These same environmentalists repeated their request three days after the Sandinista victory, when the new government faced the monumental task of rebuilding and transforming a hobbled society. More than 50,000 people had died in the revolutionary war. The United Nations' Economic Commission for Latin America and the Caribbean (ECLAC) estimated that Nicaragua had lost \$2.2 billion from material damage, theft, economic inactivity, and money sent out of the country. With a foreign debt of nearly \$2 billion, the need to export agricultural goods had never been greater.

Nevertheless, the Sandinistas initiated a bold environmental policy. They responded to the environmentalists by establishing IRENA and bestowing the environmental agency with substantial power, including the requirement that anyone wishing to remove trees had to obtain its permission. With headquarters in Managua, field offices throughout the countryside, and a staff of 600, IRENA was enlisted to protect, inventory, and manage Nicaragua's natural resources.

IRENA has initiated projects in reforestation, watershed management, national parks, pollution control, wildlife conservation, and environmental education. The agency receives material and human aid for this work from Cuba, Denmark, France, Holland, Mexico, Norway, the Soviet Union, and Sweden. Help also comes from organizations such as the United Nations Environment Programme, the International Union for the Conservation of Nature and Natural Resources, and the Organization of American States. U.S. citizens affiliated with private organizations lend assistance; the U.S. government does not.

Early IRENA studies showed that ecological degradation was worst on the western side of the country

around León, where cotton plantations had destroyed most of the dry tropical forest remnants and displaced peasant farmers. The Western Erosion Control Project was formed in 1982 to reduce the environmental impact of intensive agriculture and restore soil productivity to over half a million acres. Through this project, Nicaragua has planted windbreaks, engaged in reforestation efforts, and stabilized eroding gullies.




In 1985, when 4,220 torrent-regulating dikes helped curb severe soil erosion, a new phase of this effort began, "The Heroes and Martyrs of Veracruz Project." This focuses on the recuperation of land between La Paz Centro and Chinandega. At the same time, it aims to improve living standards through diversified economic activities—such as tree farming, fishing, and tourism—that rely on maintaining the environment. The effort covers about 800 square miles, stretching from volcanic ridges on the east to Pacific beaches on the west.

IRENA also created a National Park Service in 1983 and targeted 18 percent of the nation's territory for protection, including volcanic slopes, vast wetlands, pine barrens, and tropical rain forests. If the plans are carried out, the proportion of land set aside for national parks will be one of the highest in the world. With 3 million people in a territory the size of Pennsylvania, the country can accommodate parks, tree farming, and both subsistence and export agriculture.

The first step has been developing Masaya Volcano National Park, 15 miles south of Managua. Though founded under Somoza, the park lacked facilities and offered few educational attractions until the Sandinistas took power. In 1987, a visitor center and natural-history museum opened. Among the park features are an active volcano, desolate lava fields, and a crater lake ringed by undisturbed forest.

Tackling deforestation is more difficult. Despite its new environmental ethic, Nicaragua continues to face social and economic conditions that threaten forest lands. Foreign timber companies are no longer allowed to clear-cut pine barrens, but slash-and-burn agriculture, development projects, and fires still contribute to deforestation. Moreover, wood provides half of Nicaragua's energy, including 90 percent of household fuel and 25 percent of industrial fuel. The country is losing 2,000 square miles of forest annually. At this rate, its forests will disappear by the year 2025. The economic embargo hampers oil imports, further threatening forest products, and U.S. pressure on Mexico and Venezuela to halt oil shipments to Nicaragua exacerbates the situation.





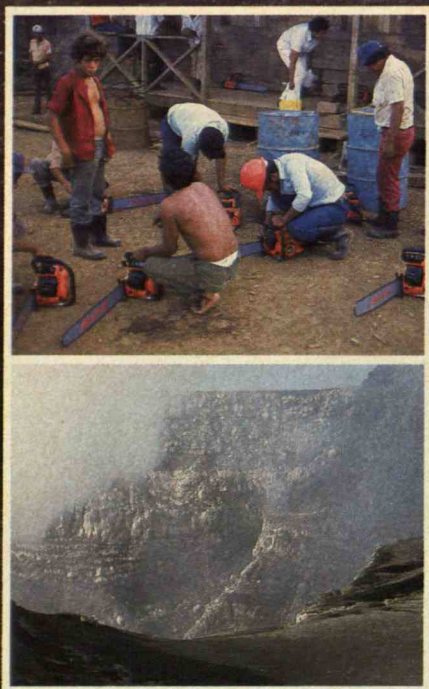
**Development, fires, and slash-and-burn agriculture have long contributed to deforestation in Nicaragua. Also, much of the water is polluted, including Lake Managua (inset above). And pesticides continue to harm farmworkers (below)—although less so than in the 1960s and 1970s, when Nicaragua and Honduras led the world in pesticide poisonings and deaths.**

To address deforestation, IRENA has instituted major tree-planting projects, and nurseries have begun to grow 2 million trees annually. Even more important, the Sandinistas have undertaken an agrarian-reform program. Although the intent is to correct economic inequities, that effort has also slowed the advancement of the agricultural frontier. In redistributing fertile lands so peasants can grow their own food, the government has nearly stopped migration to the eastern rain forest. By the beginning of 1986, the Ministry of Agriculture had distributed half Nicaragua's farmland—4.52 million acres—to nearly 90,000 families. The land had belonged to Somoza and other large landowners who fled the country.

However, as late as 1983 the ministry continued to allow peasants to clear rain forest for food. Only after coming under fire from IRENA for policies "against the principles of conservation" did it limit food production to subsistence farming and begin promoting ecologically sustainable crops such as African palm, coconut, and cocoa. These plants are perennials and also draw their nutrients from deeper in the earth, reducing the disturbance to fragile soils.

Pesticide regulations instituted since 1979 are both exemplary and unusual for developing countries. In 1980, the government persuaded Pennwalt to reduce its effluents by more than two-thirds. From 1979 to 1981, the government banned DDT, BHT, endrin, diel-





**Despite the contra war, the Sandinistas have implemented enlightened environmental practices. On the east coast, an African palm project (inset above) is adding a sustainable crop to the economy, while just south of Managua the national park at Masaya volcano (below) is gaining support after years of neglect.**

drin, Phosvel, and DBCP, replacing these dangerous chemicals with more expensive but less harmful synthetic pyrethroids. The National Pesticide Commission, created in 1981, oversees imports and has introduced Spanish labels for pesticide products as well as color-coded labels for people who cannot read.

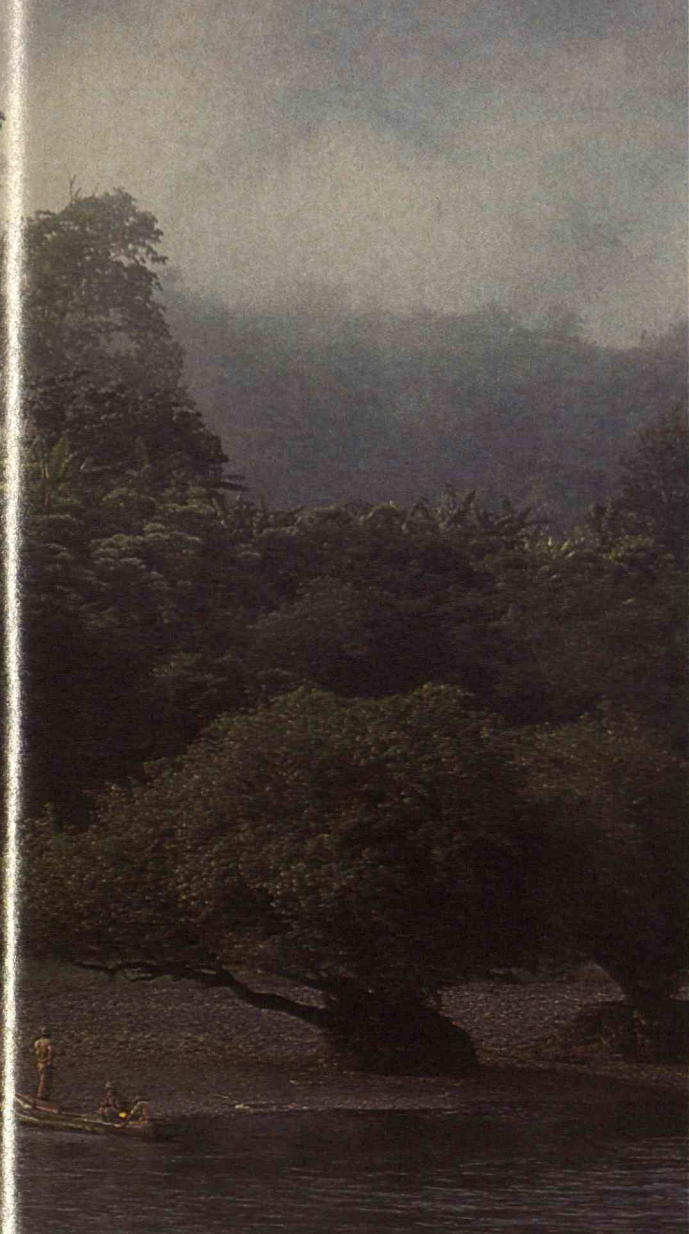
Yet because cash crops must still be exported to earn foreign exchange, the Ministry of Agriculture subsidized pesticide costs to growers up to 95 percent until recently. These heavy subsidies tended to encourage the use of pesticides for both export and domestic crops. In the case of coffee, the herbicides paraquat and 2,4-D have been used in southern Nicaragua at rates averaging 35 percent above recommended doses. This has been necessary to control weeds during the wartime labor crunch. A pesticide-monitoring project sponsored by CARE International counted 578 poisonings in 1987 around León, where pesticides have killed an average of 12 people annually in the mid-1980s. These figures

are alarming, but data for comparison are hard to come by, even in records on U.S. farm workers. Nicaragua's efforts to monitor poisoning are notable.

Some of the country's most promising pesticide-control projects involve integrated pest management (IPM), which relies on natural enemies, biological control agents, and limited amounts of chemicals. In 1980, the Ministry of Agriculture resumed and strengthened a former United Nations test program in IPM with cotton. Within a few years, this program, combined with government regulations, lowered pesticide imports by 45 percent.

According to Julio Monterey, director of the ministry's Crop Protection Center, Hercules Chemical Co., which still manufactures toxaphene near Lake Managua, is considering a joint venture with Nicaragua to produce BT. This natural bacterium kills larvae of economically damaging pests like caterpillars that attack corn, cotton, or tomatoes. Experiments with para-





*Senator Patrick Leahy of Vermont  
has called the Nicaraguan environment a  
“silent victim” of the war.*

IRENA has banned the export of endangered species, and by 1982 it had established seasonal hunting bans for 26 endangered species of mammals, 19 bird species, and 4 reptile species.

### The Number-One Environmental Problem

These ambitious plans would be difficult to pursue in the best of times. Like any Third World nation, Nicaragua must maneuver through the social, political, and economic hardships that underdevelopment has engendered. But on top of that, Nicaragua's embattled economy is plagued by scarcities, 20,000 percent inflation, and a U.S. embargo that violates the Geneva convention in the absence of a declaration of war. Between 1980 and 1987, the fighting cost Nicaragua \$3.5 billion. Over 20 percent of these losses stemmed from disruptions in agriculture—the life-line of the economy.

The United States has also used its political and economic influence within the Inter-American Development Bank (IDB), the World Bank, and the International Monetary Fund to block multilateral loans to the Sandinistas. For example, in late 1983, the IDB finally approved a \$30 million loan for Nicaragua's Atlantic coast fishing fleet after years of U.S. opposition. And stalling by the Reagan administration killed a \$58 million agricultural loan in 1985. Such loans would give the Nicaraguan economy breathing space for innovation, thereby helping protect some vanishing Central American habitats.

The history of a bi-national park on the Costa Rican border illustrates Nicaragua's economic and environmental predicament. In late 1986 President Daniel Ortega proposed a “peace park” for the border zone, an area from which contras had once launched raids into southern Nicaragua. Straddling two nations, the park would promote both conservation and peace.

The decision to make the proposal in the midst of war underscores the Sandinista commitment to environmental protection. However, in early 1987 the state of the economy led a vice-minister of industry to grant a private Costa Rican logging firm a 20-year concession on 1,000 square miles of virgin tropical rain forest in the Río San Juan watershed—the area designated for the park. After six months of heated debate, as well as pressure from environmentalists in North America and Europe, Ortega canceled the concession and put the park back on track.

Quick action by members of the Association of

sitic nematodes and *Trichogramma* spp. wasps, which lay their eggs in larvae of other insects, also show promise. Both food and export crops would benefit from the development of biological control agents.

Polyculture mixtures may increase yields and decrease insect damage, as research from Costa Rica with growing tomatoes and corn together suggests. Tomato producers for Nicaragua's fledgling tomato-processing industry are just learning of these practices.

The properties of the neem tree (*Azadirachta indica*) may prove effective in pest control, too. Neem's insecticidal power is well-known in its native India, where additional uses include soap, toothpaste, oil, and gum. The Ministry of Agriculture, in cooperation with West German technicians, maintains a seed-production project and experimental plots in hopes of developing this multi-use product for Nicaragua.

Finally, since 1979 the government has moved vigorously to protect Nicaragua's diverse wildlife.



*The United States has blocked international loans  
that would have given Nicaragua enough breathing space to build up  
its economy and restore its environment.*

Nicaraguan Biologists and Ecologists (ABEN) was critical in stopping the shortsighted logging deal. A non-government organization of Nicaraguan professionals, ABEN claimed that "the destruction of this forested area [would] destroy the hydrological balance of the San Juan River watershed." Proponents of the logging accord cited Nicaragua's economic crisis, the U.S. embargo, and the country's enormous debt. They believed that Nicaragua's \$2.5 million annual income from the logging would outweigh ecological costs.

On February 5, 1988, the Costa Rican and Nicaraguan ministers of natural resources signed a letter stating their intent to create the park across their common border. The idea has since grown into the International System of Protected Areas for Peace, whose Spanish acronym—SI-A-PAZ—means "yes to peace." SI-A-PAZ could total 1.5 million acres. Nicaragua has proposed an extensive multi-use reserve on its side of the border, encompassing wetlands south of Lake Nicaragua and over 1,000 square miles of rain forest. Costa Ricans are proposing to extend their country's existing wildlife refuges and corridors to connect with the border park. Commenting on the joint conservation effort, Nicaragua's then-national parks director Lorenzo Cardenal declared, "We are hoping to create . . . a world-wide model of sustainable tropical rain forest development."

However, the success of this innovative approach to regional peace and ecological conservation depends not only upon the good faith of both countries but upon continued peace negotiations between the Sandinistas and the contras. And since the U.S. government created, trained, and funded the contra effort, lasting peace also requires the eventual participation of Washington.

Indeed, in 1987 Lorenzo Cardenal said that "the U.S.-backed contra war is our biggest environmental problem." Sen. Patrick Leahy (D-Vt.) has called the Nicaraguan environment a "silent victim" of the war, pointing out that as early as 1983, "over 400 square kilometers [about 154 square miles] of a reforestation project funded by the Inter-American Development Bank [before the United States moved to block such loans] were destroyed by the contras."

Since 1986 the war has forced Nicaragua to put geographically isolated programs on hold, delaying plans for a sustainable forest-products industry. Contras have killed or kidnapped 75 employees of IRENA and the State Forestry Corp. In a 1983 attack, contras razed 150 square miles of reforested coastal pine at the Northeast Forestry Project.

War and an ailing economy have also led the Sandinistas to streamline and restructure many governmental agencies. For IRENA, this has meant being subsumed into the Ministry of Agriculture. Nicaraguan environmentalists see little merit in giving a ministry committed to production the responsibility for protecting natural resources.

According to Howard Heiner, a veteran U.S. forestry consultant who has worked in Nicaragua since 1983, IRENA had to cut 95 percent of its field staff late last year. In the northern town of Estelí, IRENA reduced its staff to 4 from 64. The central office in Managua escaped total ruin, losing only 40 percent of its workers. Because of inflation, those who remain live on what they term symbolic salaries.

In the northeast corner of the country, staff and resource shortages in 1987 prevented workers from containing the annual forest fires. Instead of the anticipated 5 percent burn, fires claimed 93 percent of the area. Nationwide, almost all forestry projects are on hold. Only SI-A-PAZ, the Heroes and Martyrs of Veracruz Project, and the program in the northeast sponsored by the Inter-American Development Bank still operate. Instead of the targeted 18 percent, only .1 percent of Nicaragua's territory is protected in national parks.

Faced with the country's need for cash, IRENA lifted some bans on wildlife export in 1985, and the Ministry of Agriculture's IPM program has been crippled. Although the Sandinistas have made building sewage-treatment plants for Lake Managua a priority, the government has no money to move ahead with this multi-million-dollar task.

### **Hurricane Joan: Natural Destruction**

Even though Nicaragua already faced a daunting battery of environmental challenges, nothing could have prepared it for Hurricane Joan. On October 22, 1988, 150-mile-per-hour winds landed full-force on Nicaragua's eastern doorstep, resulting in what Minister of Agriculture Jaime Wheelock has called "an ecological, economic, and agricultural disaster for Nicaragua." Canada, Cuba, Czechoslovakia, Costa Rica, Guatemala, Holland, Mexico, Norway, and Sweden all responded with aid. But the Reagan administration refused to send anything to Nicaragua. Jamaica had received about \$100 million from the United States almost immediately after Hurricane Gilbert had struck earlier in the season.

Moreover, although the contra war has grown less





**On October 22, 1988, Hurricane Joan's 150-mile-an-hour winds struck Nicaragua, causing what Minister of Agriculture Jaime Wheelock has termed "an ecological, economic, and agricultural disaster."**

bloody, some attacks continue. Contra fire stopped a marked Red Cross vehicle that was evacuating civilians from Nueva Guinea, wounding the driver and two passengers. In mid-December 1988, nine hurricane relief workers were kidnapped along the Río Coco separating Nicaragua and Honduras. An independent contra band led by Tiger 17, who controls a military fiefdom on the Honduran side of the river, is presumed responsible.

Certainly the victims merited assistance on humanitarian and environmental grounds. One of Central America's worst natural disasters, the hurricane killed 320 people, with 178 seriously injured and 110 missing. In 12 hours, the floods and wind destroyed 40,000 houses, leaving 300,000 people homeless. ECLAC estimates the damage at \$840 million, 40 percent of Nicaragua's annual gross domestic product. Minister of Foreign Cooperation Henry Ruiz believes that Nicaragua's gross domestic product will be reduced 25 percent this year because of the devastation. Last year, it grew 1.5 percent.

ECLAC found that Joan eroded 24,700 acres of farmland beyond use, buried almost 2 million acres more under sediment, and severely damaged 22 percent of the rain forests. Some 22.7 million cubic yards

of lumber valued at \$1.6 billion are strewn across inaccessible landscapes. Cardenal says that "in four hours the hurricane advanced deforestation in Nicaragua by 15 years."

The Río Escondido watershed, which stretches from Bluefields on the Atlantic coast inland past Rama for more than 100 miles, is completely destroyed, eliminating a vital overland transportation link between the Atlantic and Pacific sides of Nicaragua. Sediments washing toward the Caribbean in the wake of the destruction will muddy coastal ecosystems, threatening critical estuarine shrimp and lobster nurseries. Swedish environmentalists studying the hurricane's effects estimate that it will take 60 years for the rain forest to grow back, during which time soil erosion and flooding will continue.

Solving these problems will test Nicaragua's ingenuity. And that challenge cannot be met without regional peace. Too often, U.S. economic and military aggression have forced the Sandinistas to revise priorities and emphasize short-term production over environmentally sound development. If creative solutions for environmental protection are to survive and serve as a model for other Third World nations, Nicaragua must survive. ■



# Reviews

## TELEVISION

### Insiders' History of the Bomb

*War and Peace in the Nuclear Age*  
Produced for the Public Broadcasting Service  
13 1-hour episodes

BY PAT AUFDERHEIDE

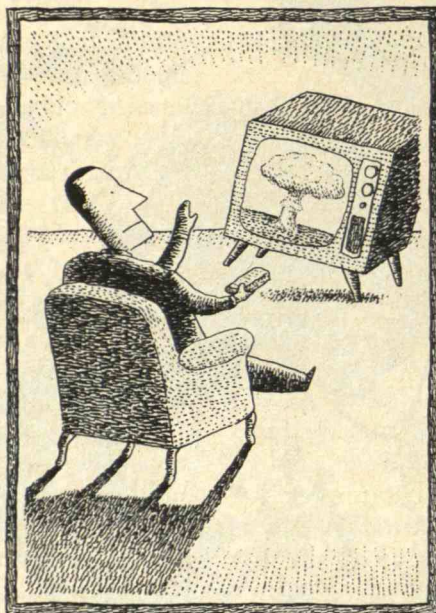
**W***ar and Peace in the Nuclear Age*, aired from January to April, is public television at its didactic best. "In the past, nuclear matters were considered too complicated for the general public," explains the executive producer, Israeli documentary filmmaker Zvi Dor-Ner. "Knowledge was held by the 'nuclear priesthood'—defense experts, scientists, and politicians. Our series attempts to make this knowledge available, to displace the feeling that the management of nuclear affairs is beyond public influence or understanding."

Does *Nuclear Age* succeed on the terms its creators have set for it? Yes and no. By relying on in-depth interviews with politicians and scientists, along with some military voices, the series takes us inside the logic of the nuclear priesthood and lays bare the reasoning and the pressures driving its members toward escalation and proliferation. But the paradoxical result of this insider focus is to suggest that there is no real alternative to the continuing militarization of nuclear technology and little possibility for the public to influence nuclear affairs.

#### Politics Is Harder Than Physics

*Nuclear Age* uses as its guiding aphorism a comment by Einstein: "Politics is harder than physics." The over-arching point of the series is that nuclear technology has been incorporated from the start into existing political structures and conflicts, both within and among nations. "A revolutionary technology became, through the bureaucratic process, an ordinary focus of government affairs," says MIT political scientist Eugene Skolnikoff, who served on the series' advisory board.

That point becomes grimly concrete in tales of nuclear bluff and counter-bluff, escalation, face-offs between politicians and military men, and—not to be underestimated—sheer political bravado.



The contrast between scientists such as Einstein and Robert Oppenheimer, who thought deeply about the moral implications of nuclear weapons, and politicians and military leaders, who did not, is especially striking. Air Force Gen. Curtis LeMay, head of the Strategic Air Command in the 1950s, is quoted as saying that his policy was to "knock the shit out of [the enemy] before they get off the ground," acknowledging that it was "not the national policy, but it is my policy." Soviet premier Nikita Krushchev boasts of cranking out nuclear missiles like "sausages" (a lie, but not one that U.S. intelligence detected at the time). And Ronald Reagan suavely charms a press conference audience on SDI by saying, "If you'll pardon my stealing a film line, 'the Force is with us.'"

Perhaps the greatest achievement of the series is that it avoids a parochial U.S. perspective. Soviet scholars and officials describe the sense of inferiority and vulnerability that U.S. nuclear advances brought in the Soviet Union (particularly in the wake of 20 million World War II dead), and the intense pride they felt in Soviet nuclear achievements. We also learn how our NATO allies viewed with dismay the prospect of Europe becoming the nuclear battleground for the superpowers, and we gain insight into the political logic driving France and Britain to acquire their own nuclear arsenals. We watch first China, then India and Pakistan get nuclear capacity (Mrs. Gandhi describes her country's debut blast as a "peaceful explosion"), each citing reasons of national self-

determination and self-defense.

Granted, this analytic perspective does not always make for the most engaging television. Ceremonial events (Nixon shaking hands with Brezhnev, Reagan's inauguration) typically serve as visual cover for narration spelling out behind-the-scenes political decisions. Nonetheless, some episodes are gripping.

One of the most dramatic is "At the Brink," about the 1962 Cuban missile crisis. Interviews with U.S. and Soviet policymakers and tape-recordings from National Security Council meetings on the crisis portray the panic that mounted as officials groped for a middle way between capitulation and nuclear showdown. By the end, it is clear that a few politicians, not always in close communication with their own military, were playing chicken—with worldwide stakes.

#### The Invisible Public

The only problem is that by focusing so single-mindedly on the experts, *Nuclear Age* implicitly accepts their frame of reference and neglects to put their experience into a broader political and cultural context. In the process, important issues become invisible.

For example, the series never directly poses a fundamental question: What is the actual nuclear military policy of the U.S. government? In his recent book *The Button: The Pentagon's Strategic Command and Control System*, Daniel Ford argues that the U.S. military appears still to embrace an offensive strategy of first strike. And Gregg Herken, chair of the Space Sciences Department at the Smithsonian's National Air and Space Museum, has claimed that the superpowers' actual policy conflicts with their declared deterrence policy. Herken has recently charged that *Nuclear Age* "sidesteps the question of what American nuclear weapons policy is, and who makes it." You'll find oblique insider debates over first strike in the series, but only if you know what you're looking for.

Moreover, despite the goal of encouraging public debate, the wider cultural impact of nuclear policy is oddly absent from the series. In award-winning films such as *Radio Bikini*, *Atomic Cafe*, and *Are We Winning, Mommy?*, independent filmmakers have probed how ordinary people responded to the nuclear era. Such documentaries remind us that the American public is not just uninformed but misinformed about the realities of nuclear history—and not by accident. The U.S. government and the mass media have frequently kept key details from



the public and otherwise manipulated opinion and managed dissent. Since *Nuclear Age* fails to tell this story, it cannot address how an informed public might actually shape the future direction of nuclear policy.

Of course, no television documentary, even one with 13 episodes, can do everything. In the end, *War and Peace in the Nuclear Age* reflects caution as much as ambition, and it is better at explaining how we got here than at providing a vision of how we can go forward. Still, the series is likely to become a basic text in a nuclear age that needs more, and better informed, public participation. ■

PAT AUFDERHEIDE teaches in the School of Communications at American University in Washington, D.C., and is a senior editor of *In These Times*.

## BOOKS

### Managing Research

*Science and Corporate Strategy*  
by David Hounshell  
and John Kenly Smith, Jr.  
Cambridge University, \$39.50

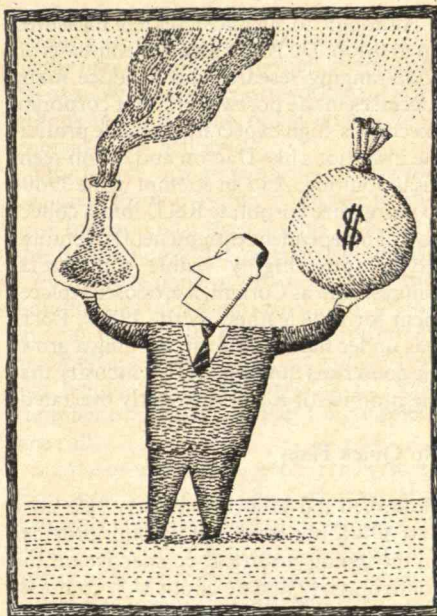
BY GEORGE WISE

Don't be put off by the heft of its 756 pages or the heroic picture of chemistry triumphant on its cover. *Science and Corporate Strategy: Du Pont R&D, 1902-1980* is no coffee table celebration of better things for better living through chemistry. It's first-rate business history—and an intriguing business mystery.

The history tells of 78 years of Du Pont R&D, a period during which company scientists created nylon, neoprene, Teflon, Orlon, and Dacron, and won two Nobel Prizes. The mystery is why research, which did so much for Du Pont, came by the late 1970s to inspire so little confidence within the corporation.

Historians David Hounshell and John Kenly Smith had complete access to the rich Du Pont business archive, housed at the Hagley Museum and Library in Wilmington, Del. They also enjoyed full cooperation from the corporation and the right to present their conclusions uncensored. They have written what is by far the best account of any company's R&D effort.

As the title suggests, the authors emphasize the interplay of science and corporate



strategy. Knowledge, they argue, is not a natural resource that can be tapped at will. Rather, it is the product of specific organizational choices and business goals. In most cases, say Hounshell and Smith, a corporation's business plan directly shapes research, not the other way around. On occasion, however, research results can be so dramatic as to profoundly influence corporate strategy itself. The story of Du Pont suggests just how far-ranging that influence can be.

#### The Quest for New Nylons

At the turn of the century, Du Pont was a slow-growth explosives giant, relying for profits on market control rather than innovation. New management sought to shake up the company by creating two laboratories. One, attached directly to the company's explosives business, was aimed at improving established products and processes. The other, attached to corporate headquarters, was for more radical innovations.

The intent was to play the two labs off against each other and see which was more successful. But instead, rapidly changing corporate strategies over the next 25 years inspired reorganizations of research largely unrelated to the track record of either lab. When the company decentralized, so did R&D, to the extent of almost eliminating the central research laboratory that served the corporation as a whole. When the company shifted from a strategy of internal diversification to one of diversification through

acquisition, R&D followed. It emphasized incremental improvements in existing products rather than basic research. For example, after Du Pont bought the rights to cellophane in 1923, company scientists focused on developing a moisture-proof version of the product.

In 1926, Du Pont chemist Charles Stine, who had become the director of the central research lab, proposed yet another approach. He argued that if the company recruited outstanding chemists and gave them wide latitude to pursue fundamental research, good things would eventually result. Du Pont's management bought the idea. They did so less because of any deep strategic analysis than because the company was awash in money, mainly from stock in booming General Motors. Stine was given the go-ahead, and corporate scientists were turned loose on pure research in a building soon nicknamed Purity Hall.

Stine's tenure as the head of Du Pont research did not last long. In 1930, he was replaced by Elmer K. Bolton, who refocused Purity Hall on the bottom line. Nevertheless, a series of events had begun that would reverse the usual relationship between science and corporate strategy and shape Du Pont's R&D efforts for the next 40 years.

It was a single individual hired by Stine, a brilliant organic chemist named Wallace Carothers, who made the difference. In the nine years between joining Du Pont and his 1937 suicide, Carothers made contributions to polymer science that would almost certainly have won him a Nobel Prize had he lived. His discoveries formed the basis for the invention of neoprene and nylon, the two most profitable results of all Du Pont research. Indeed, one could argue that the profits of nylon alone paid for the 78 years of R&D described in this book.

Carothers's accomplishments were an exception to the normal role of R&D, not a repeatable strategic triumph. And yet that exception redefined corporate strategy at Du Pont. Despite the skepticism of managers like Bolton (who had overseen the nylon effort), top executives increasingly used nylon as the standard by which to measure other research results. If a handful of scientists working for a decade could create nylon, why couldn't hundreds of scientists bring forth a new nylon every decade—or thousands of scientists produce one every year? As Crawford Greenewalt, later president of Du Pont, put it in 1945: "We are interested primarily in fundamental research studies that are likely to produce new nylons."



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Although no later achievement measured up to nylon, Du Pont's renewed emphasis on wide-ranging research did produce many successes in the postwar era. But corporate executives' high expectations made profitable inventions like Dacron and Orlon seem disappointing. And an attempt in the 1960s to reorganize corporate R&D into a collection of independent entrepreneurial ventures led to some highly visible commercial failures, such as Corfam, a proposed replacement for shoe leather. By the 1970s, R&D was under fire at Du Pont, echoing a growing consensus throughout U.S. industry that the promise of R&D was vastly overrated.

### No Quick Fixes

Hounshell and Smith do not carry their story past 1980, but their rich account provides an intriguing historical perspective on the contemporary debate about U.S. competitiveness. Are acquisitions and mergers necessarily harmful to research? Not in this case: Du Pont's acquisition binge of the 1920s and its virtual merger with General Motors provided both the cash and the climate that made Purity Hall possible. Do U.S. firms emphasize research at the expense of product development? Not necessarily: alongside its aggressive research efforts, Du Pont built up the development strength that turned a nitrogen-based condensation polymer from a scientific curiosity into nylon. Do U.S. companies lack experience in forging global R&D alliances? Not always: in the 1930s Du Pont entered into a number of alliances, in part to learn from overseas rivals such as ICI of Great Britain and I.G. Farben of Germany.

Still more important in this era of quick fixes, this book reminds us that there are no shortcuts to radical innovation. Even for the most successful R&D-based corporations, new nylons will be rare occurrences, no matter how many dollars go to research or how many scientists are put on the job.

One hopes that Du Pont has not overreacted to this lesson. By 1980, some in the corporation wanted to move away from its dependence on research by staking the company's future on acquiring a big oil company. Others called for reviving the company's research effort by undertaking a bold new initiative. Du Pont executives chose to do both, purchasing Conoco and launching a major R&D effort in biotechnology.

So far, both decisions have been duds. Conoco looks like an overpriced millstone around the corporate neck. Meanwhile, "Du Pont's Big Drive to Enter Drug Field Proves

Disappointing," according to a recent headline in the *Wall Street Journal*. The accompanying article cites "problems in the lab" as a key reason.

But if one Carothers a century is enough to justify a corporate R&D program, impatience after only eight years may be premature. As this book amply demonstrates, science usually follows corporate strategy. But occasionally it can transcend it. ■

GEORGE WISE works at the General Electric Research and Development Center in Schenectady, N.Y., and is the author of *Willis R. Whitney: General Electric and the Origins of U.S. Industrial Research*.

## BOOKS

### Dilemmas of Design

*The Psychology of Everyday Things*  
by Donald A. Norman  
Basic Books, \$19.95

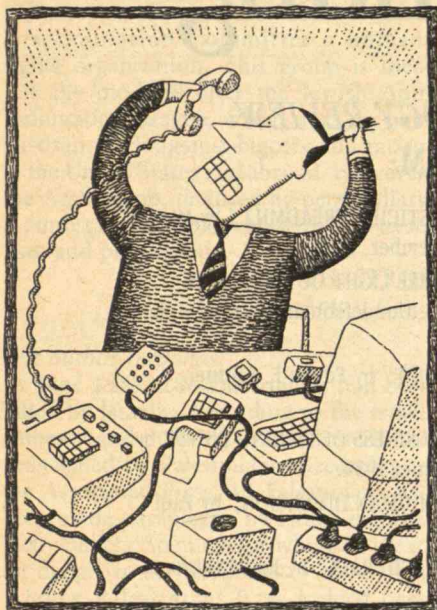
BY ROBERT G. NICHOLS

If technology exists for the benefit of people, why is it so difficult to use many of the gadgets, appliances, and other assorted devices that fill our everyday lives? Digital watches can't be set without an instruction book in hand. Computerized telephone systems confound otherwise efficient office personnel. Instead of making life easier, so much modern technology seems to make things more complex and frustrating.

According to Donald A. Norman, the problem is not the technological illiteracy of the public or the inevitable complexity of advanced technological products. It's the simple fact that so much modern technology is poorly designed. A psychologist with two electrical engineering degrees, Norman is director of the Institute for Cognitive Science at the University of California at San Diego and an expert in human-computer interaction. In *The Psychology of Everyday Things*, he persuasively argues that the engineers and designers who create new technologies need to pay considerably more attention to ease of use.

Good design confronts what Norman calls "the paradox of technology": the more a device can do, the harder it is to use. Norman claims this trade-off between "functionality" and "complexity" is not inevitable. The paradox of technology can be resolved through basic psychological principles of de-





sign that are often overlooked.

One such principle is "visibility"—making controls and their functions immediately obvious to the user. Examples of high visibility are the "record" and "rewind" buttons on a VCR. An example of poor visibility is the procedure for recording a television program at some point in the future, which usually requires elaborate programming.

A common technique to ensure visibility is "mapping"—designing a device so there is a direct correspondence between the physical action of the user and the function performed by the technology. Mapping sometimes depends on a spatial analogy. When a steering wheel is turned to the right, the automobile turns to the right as well. In other situations, mapping is the result of cultural cues—for example, the simple light switch, where up means "on" and down "off."

Mapping can be an effective method for designing more complex technical controls as well. Norman gives the example of the automatic seat adjustment control on a Mercedes-Benz automobile. The control is shaped like a seat. To tilt the bottom cushion upward, one simply moves the bottom part on the control upward; to tilt the back cushion backward, one does the same to the back part of the control.

Finally, Norman emphasizes the importance of "feedback"—some indication of whether a function has actually been achieved. Take the common doorbell. When a person pushing the button can hear the bell ring, he or she knows that it is working. If

no one comes to the door, it's safe to assume that the house is empty. But if for some reason the user cannot hear the bell, there is no way of knowing whether it is working or not. Perhaps no one is home, or perhaps the real problem is the bell itself.

The trouble with so many new technologies, says Norman, is that in the race to improve functionality, these simple principles have been ignored. He reserves his special scorn for that bane of office workers, the computerized telephone system. These systems can perform far more operations than the simple telephone. They can put calls on hold, bounce them to another phone, or link a number of phones together for a conference call.

But the procedures for getting the system to do these things are often arbitrary and needlessly complex. Because of the lack of visibility, users must memorize a different sequence of keys for each function. The lack of mapping means that different telephone systems usually have entirely different sequences for the same function. And rarely is there adequate feedback to indicate, for example, whether the last call was successfully transferred or just disconnected. Faced with such barriers, many users never bother to learn what their advanced telephones can do.

Such systems could be designed differently. Additional keys on the phone would allow each to be mapped to a single function. Feedback could be provided by a special tone that sounds when a function is completed, or the addition of a screen with menus that guide the user through more complex operations.

Norman's recommendations for what he terms "user-centered design" are generally sound, but his rambling style tends to touch lightly upon a wide variety of issues without exploring any in depth. For example, the author calls for incorporating users and their viewpoints into the design process, but ignores the considerable efforts, particularly in Europe, to involve users in the design of new workplace information systems. As a result, *The Psychology of Everyday Things*, however entertaining, leaves the reader with little sense of what it would take to make user-centered design work and thus to solve the paradox of technology once and for all. ■


ROBERT G. NICHOLS is a technical writer in the data communications field, with a background in human-factors engineering.



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To top it off, she calls the Arab Anti-Discrimination Committee a human-rights organization. This group is theoretically modeled after the Jewish Anti-Defamation League, which does do non-partisan work against bigotry and racism in the United States and abroad. However, the Arab group, financed by petrodollars, is almost entirely taken up with anti-Israel hate and propaganda.

M. TH. STROE  
Aptos, Calif.

#### *The author responds:*

By June 1988, 286 Palestinians had been killed by Israelis. According to the Israeli embassy and press reports, 4 Israelis had been killed by Palestinians. According to the Associated Press, 13 Palestinians had been made paraplegics by Israeli high-velocity bullets. So much for who is in greatest danger in the territories.

Some Palestinians have indeed been threatened by the leaders of the uprising. However, nine years of reporting in the occupied territories have convinced me that such threats aren't usually made against "law-abiding" ordinary citizens but against people regarded as quislings.

Moreover, the phrase "law-abiding Arabs and Jews" conveys the notion that everyone is equal under one rule of law in the occupied territories, whereas in fact there are two rules of law. One is for Jewish settlers who are able to vote in Israeli elections and who have easy access to valuable resources: permits for well drilling are virtually automatic, and settlement housing, education, and even food staples are government subsidized. An elaborate, arbitrary code governs Palestinians, on the other hand. Since 1967 it has allowed Israel to confiscate over half the West Bank land once owned by Palestinian farmers. Thousands of Palestinian Arabs have been jailed without charges or trial; Arabs must carry I.D. cards much as black South Africans must carry passes; Arab wells are metered and few if any drilling licenses are granted. Four Palestinians who threw Molotov cocktails during the uprising were sentenced to eight to ten years in prison, while the Israeli soldiers Ya'ir Nisimi and Dror Cohen who used a bulldozer to bury Palestinian Arabs alive got two and a half months.

The occupation has caused the current uprising—not "extremist Arab groups." The notion that a hostile Arab minority has terrorized the friendly natives is one

endorsed these days in Israel only by the far right. Increasing numbers of Israeli politicians and citizens, as well as members of the American Jewish community, share my views.

As for my facts on CS gas, they come from American and Swiss medical, military, and pharmacological journals.

#### PLANTS UNDER PRESSURE

I am disturbed by the lack of balance in "Management by Stress" by Mike Parker and Jane Slaughter (*October 1988*). I see no mention there of the plant closings and downsizing that result when companies lose market share to aggressive competitors. The costs in human suffering are not to be ignored.

As a manager of a manufacturing organization, I have enormous respect for the intelligence, energy, and capability of working people. I believe it is essential for individuals at all levels of industry to labor together—both to preserve human values and to compete effectively in today's economy. But instead of providing guidance, Mr. Parker and Ms. Slaughter seek to preserve the separation of "labor" and "management" that so often diffuses our focus. Worse still, they do not consider whether workers who are "managed by stress" would be better off if they lost their jobs.

HARRY R. DRAB, JR.  
Westfield, Mass.

#### FOILING SURGICAL IMPLANTS

I applaud "Artificial Organs: Learning to Live with Risk" by Pierre M. Galletti (*November/December 1988*). As a developer of implants, I know the regulatory hurdles the author describes so well. As a manufacturer of such medical devices, I can add that product-liability litigation can play havoc with them if they ever make it to the marketplace.

Even in informed-consent discussions, patients appear to hear only the benefits of implant surgery and not the risks. Especially vulnerable to litigation are implants used in treatment plans that require patients to modify their behavior or secure ancillary care. When a certain percentage of these devices fail because of patient noncompliance, a member of the bar is ready to file suit. Although the facts may absolve the manufacturer, the cost of defense may well sink the product and perhaps the enterprise.

CHARLES A. HOMSY  
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# Reporter

## Still More on Air Safety

Twice in the past two years *Technology Review* has looked at what's happened to air safety since airline deregulation started in 1978. (See "Is Air Safety in Jeopardy?" August/September 1987, and MIT Reporter, July 1988.) Now an MIT study concludes that domestic jet air travel in the United States has been safer than ever in recent years, but that the record probably would have been better if airlines had not been deregulated. Arnold Barnett, a professor at the Sloan School of Management, and Mary K. Higgins, a former MIT student who is now a Pentagon analyst, have examined airline fatality statistics.

On major carriers established before the 1978 Airlines Deregulation Act, the chance of being killed on a flight was four times lower between 1977 and 1986 than it was in the early 1970s. And it was 10 times lower than in the early 1960s.

The record is weaker for the approximately 20 jet carriers formed after deregulation. Most of these airlines, which have made few flights compared with the older carriers, have never had a passenger fatality. But since some had accidents between 1979 and 1986, the risk of death on these carriers was estimated to be 12 times that on the established airlines. Barnett and Higgins therefore find fault with the familiar argument that because it is generally less dangerous to fly now, deregulation has not harmed air safety.

## Noise over Radio Reception

Bypassing an initial peer review of his research, MIT electrical engineering professor Amar Bose recently held a press conference criticizing FMX, a new FM radio broadcasting technology that could have a market worth billions of dollars. He alleged that the system decreases the range of stereo reception and degrades signal quality.

Bose's actions have upset Emil Torick, a co-inventor of FMX and president of Broadcast Technology Partners (BTP), the firm developing and marketing the broadcast system. Torick claims that Bose's presentation was "misleading in the extreme," and accuses him of attempting to manipulate the press. Torick also criticizes financial support afforded the research by the Bose Corp., an audio-equipment company that Bose founded and chairs. He

suggests that financial motives may have shaped Bose's conclusions.

Not surprisingly, Bose argues that his research is sound and claims that his company, which manufactures one FM receiver and no broadcast equipment, has no financial interest in the success or failure of FMX. He alleges that BTP threatened him with "great personal liability," citing telephone calls and letters he and his co-researcher at Bose Corp., William Short, received before their press conference. Torick denies that his firm or its lawyers made any such threats.

FMX is designed to reduce noise, leading to improved reception and stereo broadcast range. An FMX generator adds a component to the FM signal that duplicates the part most susceptible to noise. The result is supposed to be a stereo signal existing receivers can handle and FMX receivers can pick up at a greater distance.

Bose admits that FMX should perform as advertised under ideal conditions. But he charges that in the real world the FMX signal worsens the effects of a condition called multipath. Multipath results when radio waves bounce off obstructions such as high-rise buildings and interfere with one another at the receiver. The erratic or distorted reception that drivers hear on mountain roads or among skyscrapers is the result of multipath. Bose claims that a mathematical model he has developed proves that in the presence of obstructions, the extra component in the FMX signal worsens multipath.

To test this hypothesis, Short asked WMBR, MIT's student radio station, to

broadcast FMX and FM signals. He recorded both with a mobile receiver that could switch between FMX and FM along a route in the Boston area. He concluded that the FMX transmission was inferior to traditional FM, and that the FMX receiver did not perform as well as a conventional receiver when picking up FMX signals.

BTP has released a mathematical analysis purporting to find errors in Bose's model. Torick also charges that WMBR's equipment was improperly adjusted.

Torick draws confidence from the acceptance of FMX in the automobile-stereo market, which has annual sales of \$3.9 billion. Several manufacturers, including Alpine and JVC, recently announced their intention to offer FMX receivers. One notable exception is Delco Electronics, the world's largest manufacturer of automobile stereo systems. It has evaluated FMX and decided not to offer stereo equipment using the technology. A Delco spokesman said that the company, which produces audio systems for General Motors luxury cars in a joint venture with Bose Corp., has no plans to offer a product competing with FMX.

Commercial stations have used FMX for a total of 125,000 broadcast hours without listener complaint, according to Torick. Engineers contacted at several FMX stations have generally agreed with BTP's assessment of the technology's quality, although some industry observers have noted that listeners might find it difficult to detect increased multipath distortion without a basis for direct comparison.

—David P. Hamilton

MIT Reporter continues on page 80

## MIT in TR . . .

Alice H. Amsden's article, "Asia's Next Giant: How Korea Competes in the World Economy" on page 46, comes to *Technology Review* by way of a highly valued source, Bennett Harrison.

Harrison, a professor in the MIT Department of Urban Studies and Planning, contacted us in 1986 to see whether we might be interested in a book he was writing with Barry Bluestone, Frank L. Boyden Professor of Political Economy at the University of Massachusetts. We decided that the thesis of the book (*The Great U-Turn*: Basic Books, 1988), which was primarily economic, did not focus enough on technology for us. Aha, responded Harrison, if you want a piece mixing economics and technology, get in touch with Stephen S. Cohen

and John Zysman, co-directors of the Berkeley Roundtable in International Economy at the University of California. That connection led to our February/March 1987 article adapted from the book *Manufacturing Matters: The Myth of a Post-Industrial Economy* (Basic Books: 1987).

Our next connection with Harrison was one from which we continue to enjoy the fruits. Last year he agreed to write a column for *Technology Review* every other issue. Still, he obviously feels he can contribute more to the magazine. Thus, when Amsden joined his department as a visiting professor this year, Harrison again put us onto an author with a novel outlook. We appreciate Ben Harrison's contribution as a silent "soliciting editor."



# Reporter

## The Bleeding Edge

Remember the promises for the 1980s—do your banking and pay your bills with your touch-tone telephone, write your airline tickets on your personal computer? As this decade began, “strategic information systems” (SISs) to automate such transactions were predicted to be a \$7 billion industry by 1990.

It's not happening. For every successful SIS, such as Merrill Lynch's money-management program, there are a score of failures, many disastrously expensive. Telephone-based banking systems are an example. Because telephones offer no display of the data sent over the lines, people have been afraid of making “irreversible” mistakes, write MIT's Sloan School of Management assistant professor Chris F. Kemerer and former graduate student Glenn L. Sosa in a recent paper. Therefore people have refused to give the systems access to their money.

SIS entrepreneurs have also suffered from delays and cost overruns, partly owing to a “tremendous shortage” of people with both technical and business skills to design and maintain systems. Writing the software needed to run the systems has proven expensive and time-consuming as well.

Moreover, the leading edge has often been the “bleeding edge,” to use Kemerer and Sosa's phrase. Success in the SIS business has not always been crowned with financial reward, because systems are hard to patent and easy to copy. That's the lesson the banks that first invested in automatic teller machines have learned. The competitive advantage these banks acquired has quickly eroded as the machines have become “strategic necessities” for the entire industry.

## Information Technologies: Sometimes Too Much

Strategic information systems haven't been the only information products that have caused problems in the 1980s. Gary W. Loveman, an MIT economics graduate student, reports that overall, manufacturing companies investing in information technologies did not get as high a return on investments between 1978 and 1984 as they would have had they spent less on those systems and more on labor or on

other kinds of capital.

Loveman has found that firms used an increasing share of their investment budgets on information technologies, particularly mainframe computers and office-automation systems. Eventually many companies spent far too much on the equipment, Loveman writes in a recent paper for the Management in the 1990s program at the MIT Sloan School of Management.

Inadequate organizational structures were partly to blame for these decisions. Many companies were trying to decentralize so that they could remain competitive. Thus, expenditures on information technology often did not reflect a coordinated, top-down business strategy. Instead, different groups within one company bought incompatible systems—which didn't help networking.

In addition, poor budgeting of information-technology expenditures took its toll. Because they didn't know just what benefits would accrue from the technologies, companies failed to perform adequate cost-benefit analyses and made poor investment decisions. Loveman also notes that “in many cases, firms bought into evolving technologies or systems too soon or too heavily, when waiting might have been better.”

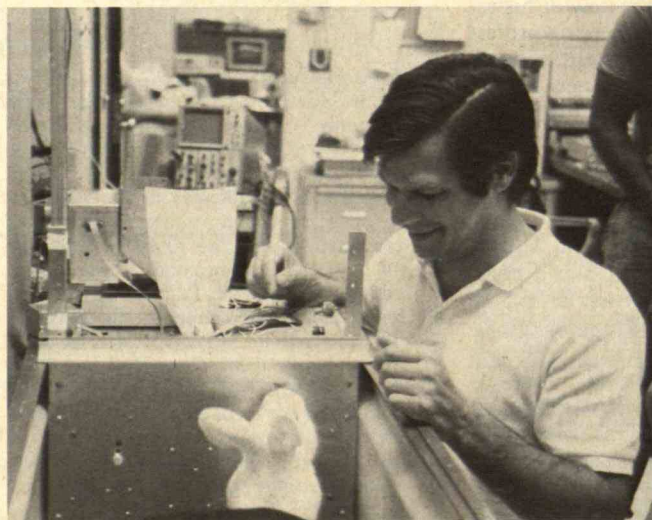
Loveman points out that the difficult business period of 1978 through 1983 may have influenced his results. “Many firms were in the midst of layoffs [and]

leaving or entering markets,” he says. Therefore they did not “focus on using [information technologies] effectively from a business standpoint. The result was a growing capital stock [of information technologies] and an associated group of managers [and] technologists . . . immersed in a turbulent sea, without coherent direction.”

Many companies have made some progress in recent years by reorganizing and improving their budget decisions, according to Loveman. Still, the central problems in managing information remain, so “there is cause for no more than guarded optimism” about the future productivity gains from information technologies.

## Strengthening U.S. Industry

The MIT Commission on Industrial Productivity, appointed by President Paul E. Gray in 1986, will publish its final report May 8. *Made in America: Regaining the Productive Edge* (MIT Press) will identify key weaknesses in American industrial performance and propose ways to overcome them. This is the first major MIT commission in the post-World War II era to issue a public policy statement on a problem of national concern. *Technology Review* will carry a full account of the commission's work in the August-September issue.



**Professor David J. Edell of the Harvard-MIT Division of Health Sciences and Technology hopes to learn how to develop artificial nerve systems for people paralyzed from spinal-cord injuries. Currently he is implanting microelectrodes into rabbits' spinal cords to study natural nerve networks. The work could result in an implant that would use signals from a human's spinal cord to control the rest of the body.**



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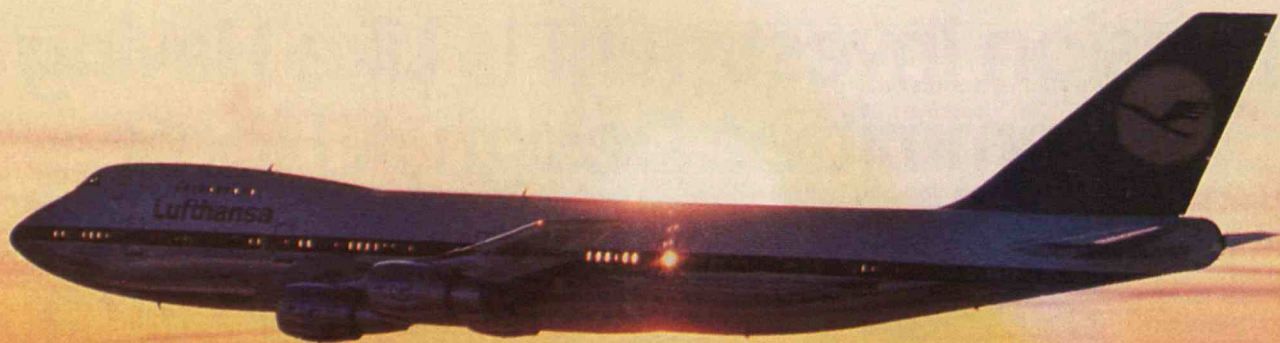
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